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ABSTRACT

Papers on information technology which were presented at the 1985 International Federation of Library Associations (IFLA) conference include: (1) "Technology in the Public Library: The Impact on our Community" (Kenneth E. Dowlin, United States); (2) "Software Evaluation: Sources and Resources in the United Kingdom" (Stephen Flood, United Kingdom); (3) "Exploiting Technology to Build a Canadian Library and Information Network" (Cynthia J. Durance, Canada); (4) "Linked Systems Project in the United States" (Sally H. McCallum, United States); (5) "Assimilating the Micro: The Use of Microcomputers in Public Library Services" (Leena Siitonen, United States); and (6) "Statistical Measures for Library Accountability" (Daniel O. O'Connor, United States). (THC)

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IFLA GENERAL CONFERENCE, CHICAGO

Division: Management and Technology

Section: INFORMATION TECHNOLOGY

1985

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TECHNOLOGY IN THE PUBLIC LIBRARY

The Impact on our Community

by

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ABSTRACT

The Pikes Peak Library District in Colorado, USA has created one of the most computer intensive libraries in the world. The current computer provides almost one terminal per employee, and the new system being installed will provide three terminals per employee. The availability and utility -- almost all of the employees use the computer in their normal work -- of the computer system creates an organizational environment vastly different from that found in a library without automation. In addition, the use of modern information technology by the library has significantly changed the perception of the average person in Colorado Springs concerning the role of the library.

We live in a world of changing technology, and as the world moves into the information age it is crucial that societies have a policy that guarantees access to information and knowledge for the average person. All people are entitled to access to information that will help them cope with their environment, better their situation, and enrich their lives. In the 21st century denial of access to information and knowledge will constitute disenfranchisement at the very least, and tryanny at the worst. I contend that a public library is the appropriate institution for publicly subsidized access to information and knowledge for everyone. Yet, the resistance of librarians and libraries to new technology decreases the role which public libraries will play in the information age. The implementation of new technology can be an effective instrument for change. In fact, the use of technology as a change agent can be attractive when compared to the other three: destroying the organization, reorganizing sub-units, and changing individuals (1). Today, I will address the impact of technology on public libraries by first presenting the scope of the use of technology at the Pikes Peak Library District, by presenting my observations about how the electronic environment has impacted the library internally, and then by presenting the impact of the electronic library on the community.

The Board of Trustees who interviewed me for the position of Director of the Pikes Peak Library District (PPLD) indicated that they were interested in acquiring a computerized circulation system. The library had actually budgeted funds to acquire a turnkey circulation system prior to my tenure and one of my first assigned tasks was to automate the library. My investigation into turnkey systems led me to believe that they were primitive in design and extremely limited as to functionality. With the Board's support I proceeded to design and implement our own system. It was a basic tenet of the system design that the computer would serve as a general purpose housekeeping tool, as a vehicle to expand the library's ability to collect, store, and provide access to community information, and that it would provide access to information from the home or business through a general-purpose telecommunications network. After a start on a large mainframe computer operated by the county government, the library felt a need to acquire its own computer system and staff. In fact, the county asked us to get off their machine since we were overloading it. The library's first computer, a Digital Equipment Corporation PDP 11/70 was installed in 1976 and the circulation system was brought online that year. The system continued to grow over the years until PPLD has almost one terminal per employee, and virtually every function of the library uses the computer.

In 1978 the Board adopted a long-range plan for the library that established the mission of the library as :

- to serve as the community information center
- to serve as the published materials resource center for the community
- to serve as the communications center for the community
- and to be as efficient and effective in using our resources to accomplish the mission as possible

The measure of accomplishment is that fifty percent of the population agree that the library is an effective provider of these four elements. The library has made considerable progress toward the goal and there is little question that the computer system, dubbed MAGGIE'S PLACE, has been a key system in the attainment of library goals.

A look at MAGGIE'S PLACE today shows that functions that are in operation are:

Community Information Center

- a file of community agencies (over 600 records)
- a file of community clubs and organizations (over 800 records)
- a file of adult education courses (over 3000 records)
- a calendar of community events (over 200 records)
- a community carpooling system
- an information system for the city transit system
- a file of Children Daycare Centers

Published Materials Center

- an online circulation system
- an online catalog usable by both staff and the public
- an online acquisitions system
- an online serials system

Community Communications Center

- online access to library and community resource files (agencies, clubs and organizations, adult education courses, community events, and PPLD catalog) from the home or business (over 1700 current users)

Efficiency and Effectiveness

- library-wide Electronic Mail System
- processor to processor network with bibliographic data bases and national Electronic Mail Systems
- payroll, budget, and accounting systems
- Decision Support System (to provide feedback and control)
- system-wide word processing

On March 29, 1985 the PPLD entered into a contract with Eyring Research, Incorporated to implement a new generation MAGGIE'S PLACE. Four days after the signing of the contract, $1,200,000 worth of Tandem Corporation hardware was delivered. The public access catalog, which will allow searches by any name or term in the MARC record, and the circulation system will be derived from the software developed by the Colorado Alliance of Research Libraries (CARL). Eyring, CARL, and PPLD will continue to increase the functionality of the system to meet the information and

knowledge needs of the residents of the Colorado Springs area. It is planned that circulation and the catalog will be operational by September 1, 1985 and that acquisitions and serials will be functioning on the Tandem equipment within eighteen months. The new computer, MAGGIE III, is seven times as powerful as MAGGIE II (4 processors of 4 megabytes memory each as compared to one processor with 2.5 megabytes), will have three times as much disk storage (5.4 gigabytes as opposed to 1.8), and will handle over 3 times as many terminals (300 as opposed to 96). The Tandem architecture allows the incorporation of 16 processors of 16 megabytes each into the system without any downtime in the original system. MAGGIE III could have 256 megabytes of memory, over 102 times the power of the existing system, and could support 1600 terminals. Tandem also guarantees that the system will be available 99.9 percent of the time. The acceptance test for the computer requires that it run 60 days with no more than 28 minutes of down-time.

Planned enhancements to the system are a radio frequency data-link to the mobile units; a videodisc system for storage of local documents; a sophisticated online index to local documents and historical materials; a file of community data such as housing, employment, manufacturing, and other indicators; electronic mail service for the entire community; and electronic publishing. Other kinds of community resource files under consideration are a community encyclopedia, consumer information, information for visitors, and job

information. The current Decision Support System will be enhanced to not only provide analytical data on activities in the library system, but will be designed to be predictive of future activity. For example, the books will not be permanently assigned to the separate facilities. Based on computerized analysis they will be moved between facilities in order to meet the anticipated needs of each facility; in otherwords, the collection will flow to anticipated need as opposed to being static. PPLD also plans to investigate the utility of reformating information or knowledge into formats that are better able to meet the needs of the community. The library may be the agency for converting archival material into videodisc; or inputting published material that needs continual updating into an online file. The new computer system will be a principle element in supporting the Lifelong Learning Center and the Community Communications Center in the new building that is on the drawing boards. It is anticipated that PPLD will experiment with the feasability of MAGGIE'S PLACE serving as a network node into bibliographic databases such as Lockheed and BRS with library staff having the capacity to intervene directly into the search to assist a library network user accessing the system from their residence. As soon as the programs derived from CARL are implemented, users of PPLD will have an online link with the six largest libraries in Colorado which hold over 85 percent of the titles in the state. It is anticipated that the hardware recently acquired will provide the computer system for the Electronic Library in the Pikes Peak Area.

6(12)

Internal Ramifications

What has been the impact of all of this technology on the operation of the Library? First of all, it has changed the skills required of employees. For example 86 percent of our cataloging is done by technicians, rather than librarians. This is possible since PPLD receives machine readable records of the cataloging done by the Library of Congress. Only minor modifications are made prior to entry to PPLD's catalog. Since most of the filing and revising has been eliminated it has been possible to move the processing flow from an assembly line process to one similar to that pioneered by Volvo in Sweden. Instead of having a series of steps completed by different people, each employee is responsible for all steps taken to process an item, except for original cataloging. They take a book truck of items from the receiving area and complete all activities needed to move the items into the collection. The job enrichment that is possible creates an environment where growth of an employee is recognized as a norm in the institution. The heuristic process of implementing a new and powerful computerized system places a premium on employees that are adept at problem solving and are creative.

The centralized information system that is available to all has changed the patterns of information flow, including control. For example, the online acquisitions system allows all staff to have access to the file of items on order. Each individual can monitor progress of any item from the time

that they request that an item be added to the collection until it appears on the shelf. The online budget system and regular printed reports allow the various divisions to manage their own budgets at the same time allowing management extremely current information on the status of the accounts. Electronic mail and word processing facilitates communications among the employees by providing rapid transfer of information through a system that is not dependent on location (the system is readily accessible via telephone from anywhere in North America, and with advance preparation, anywhere in the world) nor on time (the system is available via telephone 24 hours a day).

The electronic system increases alternatives for problem solving and enhancing services. For example, the current MAGGIE'S PLACE has increased access to bibliographic and holdings information from the one card catalog at PPLD to over 1800 electronic catalog access points. It is anticipated that within five years there could be over 10,000 people with access from their home or business. With computer technology it is possible to create a catalog that talks to the blind, provides large print displays for the visually impaired, translates the entry to another language, or arranges the entries in a manner that enhances its value. The filing rules are irrelevent to the user of the catalog and even to staff in technical services since the display presented can be arranged in a number of formats; in the future the user will be able to select the format that is the most appropriate.

There is little question that the online computer system has increased the control over the library's resources. An item anywhere in the library, which has eight facilities and three mobile units, can be immediately located and its status ascertained. PPLD is able to inventory nearly 400,000 items every two years with the use of battery operated microcomputers. Although the inventory system has not reached the goal established (an item to be as indicated in the computer 97 percent of the time) it has significantly increased the ability of the staff and users to locate items. As a second dimension to resource control, the Inventory Use Ratio system provides a continuous indication of the use of the different classes (128 types) of items. This data is used for selection and retention of materials.

MAGGIE'S PLACE has increased the effectiveness of PPLD. Employees have been shifted from non-public services to public services and materials are constantly shifted among facilities to meet specific needs. The time span for providing materials from the point of selection to availability on the shelf has been decreased significantly. Processing routinely processes materials in less than 48 hours and the norm is no more than five days from receipt to circulating status. Prior to the computer, throughput in processing was measured in months rather than in hours.

PPLD has numerous instances where MAGGIE'S PLACE has increased efficiency. For instance: the average time for a book to be reshelved at the main library is now 4 hours -- down from 48 hours; throughput in processing is dramatically

improved; library managers can communicate with each employee at work within seconds; the computer allows mailings to groups of supporters, such as the Friends of the Pikes Peak Library; budget preparation has been decreased by at least 50 percent; items are charged out in seconds, rather than minutes; likewise for returns; notices to people with books that are overdue are created automatically in the middle of the night. PPLD has increased its services to the community at least fifty percent with a current staff that is ten percent fewer than in 1975.

External Ramifications

The image which the individuals in the community have of PPLD is far different from the image ten years ago. PPLD is recognized as a leader in the Pikes Peak area for the use of information technology. Even though it is estimated that there are more than 30,000 home computers in the area, the use of the terminal in the library is often the first "hands-on" experience for many people. The dial-up access from the home or business is viewed as an indication of the willingness of the library to provide extra service. Most of the secondary schools have computers for dial-up access from the school library. Many students are introduced to the services of the public library by the school librarians who seek materials not found in their own collection. The ability of PPLD to create online community information files makes its service more relevant to the economically disadvantaged, to those who can't read, and to those who view

books as having little relevance to their daily activities. In recent months the library has been providing answers to nearly 7,000 questions from the locally created databases; information that is not readily available in any other form.

Many governmental and private organizations have approached the library to solve community information access problems. Examples are:

* The Pikes Peak Regional Council of Governments has contracted with PPLD to build and operate the online CARPOOLING program in an effort to lower air pollution.
* The Urban League Daycare Center Clearinghouse has contracted with PPLD to provide a current database on Daycare Centers.
* The Citizens Goals for Colorado Springs has contracted with PPLD to create and operate a clearinghouse on information concerning the rapid growth of the area.
* The Colorado Springs Transit has contracted with PPLD to create and operate the online information system for the public transportation in the city.

In addition to the concrete functions of the computer, MAGGIE'S PLACE has created a library where the organizational environment is one that encourages innovation, has generated very high expectations of the library for the staff and the community, has increased goal directedness, and has allowed increased services.

1. Everett M. Rogers and Rekha Agarwala-Rogers, Communication In Organizations (New York: The Free Press, Collier-Macmillan, 1976), p. 153.

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SOFTWARE EVALUATION: sources and resources in the United Kingdom

by

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ABSTRACT

S. Flood (UK). SOFTWARE EVALUATION: sources and resources in the United Kingdom

There are many problems associated with the purchase of software for information retrieval activities in libraries. In the United Kingdom there are a number of services now available to assist with the selection and evaluation of standard database packages. The paper presents an overview of trends in this work and provides a guide to the principal sources of advice, listings, evaluation, demonstrations and user contacts. A number of gaps in provision are pointed out, particularly associated with the quality and quantity of evaluations. An annex identifies a number of library and information service organisations in the UK with special interests in providing appropriate resources.

SUMMARY

This paper is concerned with the problems associated with selecting and evaluating standard computer software for use in library and information applications. Discussion is restricted to activities in the United Kingdom. The primary concern is to identify existing resources of information on appropriate software and assess their adequacy for the library and information professions.

BACKGROUND

In 1983 Dr. Dennis Lewis, Director of Aslib, called together a group of people from a wide variety of library, information and computing bodies to discuss evaluation of standard software for library and information services. Early attention centered around the tests that can be carried out to establish performance measures (speed of retrieval from large files etc.) and enumerate the capabilities of the software. It very soon emerged that for cost and time reasons alone such "benchmarking" would be inappropriate.

On reflection it may well emerge that such tests would not in themselves have solved the problems. In the majority of cases it is likely that some information on performance will already be available from suppliers or users. The difficulties appear to lie at a much earlier stage in the selection of software and consist of, in essence, matching the needs of the organisation with the capabilities of the software.

The Working Party therefore concentrated on encouraging a wider audience for existing services, and on identifying gaps in provision. The current work draws extensively from their deliberations. The main participants, and

their particular services for software users, are described in Annex A and referred to, in abbreviated form, at appropriate places in the text. Perhaps it is worth pointing out at this stage that, where opinions are expressed, they are more likely to be a product of personal prejudice than of official policy at Aslib or anywhere else.

DEFINITIONS

The process of software evaluation involves a wide variety of techniques that are well documented. This overview concentrates on a series of questions relating to the usefulness of evaluations:

1. Who wants to know?
2. What are the skills and motives of the purchaser?
3. What do they want to know (or need to know)?
4. What should they look for?
5. What is there available?
6. What is not available?

In order to answer these questions in a useful manner for a library audience a number of assumptions and restrictions have been made. Most concern appears to be attached to the extent to which existing resources assist novice computer users in translating application needs into a usable specification for purchase of software. This need is therefore the main theme of the paper. The only significant assumptions are that the intended audience knows that software is the means by which computers (hardware) can operate on data, and is often referred to as existing in "packages". "Applications Software" is a relatively loose term generally applied to a package given a more specific task identity. It may be worth reiterating the accepted wisdom that software purchase should precede selection of

software; the fact that this is frequently not the case is borne in mind in what follows.

There are many administrative and information-based activities that are undertaken by librarians, within traditional libraries or in specialist units, that are comparable with commercial and business applications for which there is an enormous, and increasing, volume of "off-the-shelf" software products. There is an obvious advantage in exploiting both the price and experience behind these packages, especially if the automation of routine administration frees the specialists to exercise the professional abilities for which they were trained. There is evidence from the USA, in figures produced by Professor Ching-Chi Chen[1] that "commercial" products do form an extensive part of the automation take-up in libraries, and there are indications of a similar pattern in Britain[2].

Therefore, for the purposes of further discussion, the main type of software under consideration in this paper will be readily available products which maintain databases for the various kinds of information retrieval.

The approach adopted is to examine the circumstances surrounding the selection of database software. What follows is an overview of some of the resources available in Britain to assist the search for software. This guide in fact follows roughly the same pattern as a real investigation might take:

1. Defining the problem - translating the needs of the organisation into a specification.

2. Finding the software - 2.1 creating a short list

2.2 using published evaluations

2.3 demonstrations

2.4 user views.

1. DEFINING THE PROBLEM

What to look for - If one believes the literature on this subject, which is extensive even within library and information specialisations, defining the problem can be reduced to a series of check lists. If, on the other hand, one believes consultants, the only answer is to employ a consultant. It is probable that the truth lies somewhere between these two extremes.

What is available - As has been said, the literature is extensive and readily available. In-service training courses are very much a booming business; the best sort are those provided by organisations like Aslib and the Library Association, led by fellow- professionals who pass on the experience they have gained in doing the job themselves. The training of student librarians in the use of automation deserves special mention if only to suggest that it is variable but improving. There are interesting developments in joint information science and computing studies at some colleges. Specialist advice is still very much at an early stage of development; the British Library-funded Library Technology Centre, housed within the Polytechnic of Central London, is an important initiative. There are many experienced independent library automation consultants in the UK, and the opportunity should not be missed to mention that Aslib's own experience of consultancies has reinforced the view that library automation

difficulties are often a symptom of more complicated information management problems.

What is lacking - There still appears to be no simple translation of manual library operations into computer terms but this is probably a relatively trivial task. There is much less understanding of the significance of the features that are available on computer software. It must be remembered that these represent the skill of the programmer rather than the requirements of the user; they will therefore have advantages as well as disadvantages. The relevance of fixed lengths for fields and records, limits to the size of files and the variety of database architectures require clear interpretation in library terms.

2. FINDING THE SOFTWARE

2.1 Creating a short list

What to look for - Listings of software must contain certain basic features so as to guide the potential purchaser to an appropriate short list. Necessary items in a list would seem to be -

Application - a broad categorisation of the application the program is designed to address, e.g. database, accounts etc.

Operating system - theoretically this will indicate the range of machines on which the software has been implemented. In practice there are compatibility problems which could be a difficulty if hardware is already installed.

Price - this is not only useful to compare with budgets, but is also an indicator of the "seriousness" of the program. In such a highly competitive market-place it is unlikely that package complexity will vary substantially within comparable cost categories.

Source - ideally both the creator and the vendor should be identified. This is not to encourage "purchasing chauvinism"; availability of support and appropriateness to national differences will be important.

What is available - A UNESCO project in 1983[3] produced an inventory of 188 packages for use in information services. Whilst not comprehensive, the guide to software selection is a valuable guide for users, and the inventory structure itself could be used in package selection. Before examining external listings it will be worth establishing whether offers in the organisation have already addressed this problem. At least one large UK firm has established an internal database of software, incorporating experiences, and clearly this will remove much unnecessary basic work. Others will have a list of software not following company standards. This will produce an immediate short list.

There are a number of books and annual directories[4] but there is the likelihood that a proportion of the listings will be out-of-date as soon as published and become progressively redundant. The National Computing Centre change 200 or more entries in their monthly software directory.

Some of the computer magazines aimed at the microcomputer market, particularly for the IBM PC and its imitators, produce regular listings as a guide through the proliferation of packages. This has sometimes been developed into a permanent enquiry service using more-or-less automated databases of software.

Many organisations, with varying degrees of independence and competence, will listen to needs and produce a suggested short-list. This obviously short-cuts the selection process and can be free, but anyone following this route should make proper checks that the answers are obtained from a comprehensive and current listing and really do meet specified needs. This "mutual commitment" in consulting, however casually, with experts is referred to later.

What is lacking - One frequent omission seems to be reference to the age or version of the package. In the fast-moving software business there are as many dangers in old software as in untried products.

Generally the problem is not so much the absence of information on software at this basic level, as the plethora of listings that seem only to be ends in themselves without guiding the enquirer further towards selection. In an ideal situation, especially for identifiable specific applications, the specification should lead straight to a short list and evaluation information.

2.2 Using published evaluations

What to look for - There are, inevitably, a great many differences in the quality of software evaluations. In practice the source used will

depend on the ability of the searcher to understand the computing technicalities and the extent to which the reviewer has addressed the application needs. The principle components of any evaluation will therefore be -

Technical details - Information on the capabilities and restrictions of the software in handling data. Of particular importance are the field size, record size and the limit on the number of records. Indexing strategies and various utilities connected with record creation, searching, printing and transfer should be explained. Measures of speed must be expressed in terms of the size of the database used for the tests.

Reviews - At worst these are little more than a reproduction of suppliers copy. For a journalist's review to be of much value it should at least explain some of the features that distinguish it from similar packages. There should be some evidence that the reviewer has used the system. Any review that lacks adverse criticism should be treated with caution. Some journals have used specific benchmark tests to compare software which introduces a valuable quantitative measure.

Application reviews - These are versions of the review, but dealing with information operations and usually carrisd out by librarians.

User views - Potentially of most value is the experience and opinion of existing installations. There are, however, some precautions to be taken. Published accounts of implementations

rarely tell the whole truth about problems encountered. There may be legitimate commercial reasons for disguising actual results from competitors and it will be important to identify particular external factors that may have determined the success or failure of an application.

In all these factors two questions must dominate the search: what are the specific features of the software that match the application requirements? and, does the software do what it claims to do?

What is available - Reviews in computer magazines in the UK have improved appreciably in the last few years. There is now much more emphasis on performance, special features and value for money. At least one magazine, for IBM PC and like machines, has evolved the practice of making the packages available to users for review. This practice has been taken further by Learned Information Ltd. with their software review panel for library and information packages. (See annex.)

What is lacking - Objective criteria for evaluation are extremely difficult to establish. Often no account is taken of the differing views and capabilities of reviewers. Equally, comparisons between packages do not always use comparable operations. Whilst there is much improvement in information on the working of a package in a general sense, the adequacy of evaluations is best judged in relation to the application tested.

2.3 Demonstrations

For the current purposes these are regarded as extra-mural events at which potential users look at, or are guided through, the abilities of packages.

What to look for - Much value is attributed to demonstration of software as a way of assessing value and many services exist, more or less independent of suppliers or sales and more or less tailored to the needs of individuals. An ideal situation will be to run the short-listed packages together to provide comparisons and using real data from intended applications. This is rarely achieved, so that a compromise might be to see a comparable application in a working environment (but see comments under "user views").

What is available - The Microsystems Centres of the NCC provide areas in which users can compare not only software but also machines; these use supplier-provided demonstration data. The Library Technology Centre gives more guided access to a variety of specialised and "commercial" library packages, some using sample data.

What is lacking - There are a number of serious drawbacks to extra-mural demonstrations. Group events rarely if ever give more than a tantalising glimpse of what packages do best; self-guided use can result in enormous frustration if the manuals are as impenetrable as most usually are; expert guidance can work but it is often difficult to discern where demonstrations end and consultancies begin.

What to look for - The user who has gone through the same exercise earlier is the best source of guidance on what to buy. Except that there may be a very real reason, such as commercial competitiveness or a need to provide complementary services, why such close following could be dangerous. Contact is therefore probably best at the "does it do what it says it does" level. User groups to develop new possibilities and avoid some application development lead-time are an important adjunct to individual contacts.

What is available - Eusidic has prepared a list of organisations in Europe which gives details of packages and applications; contacts with users are arranged informally. Some of the larger database systems do have user groups, although this normally applies to organisations in which the package is already in use. Otherwise contacts are usually informal or organised through suppliers.

What is lacking - There is understandable reluctance on the part of existing users to spend time with novice users, especially if they are at an investigative stage. The current ad hoc system is clearly unsatisfactory, and has a concomitant danger in that it could encourage too many "look- alike" systems. User groups could form a "pool" of information on the performance of software which would provide mutual aid and could pressure for developments. There could also be encouragement to establish "reference sites" within certain institutions, supported by users and suppliers.

There may also be value in looking at "application level" user groups to discuss software features that can be exploited for particular specialist tasks.

CONCLUSIONS

Library and information services are striving to make effective use of the new technologies to enhance their work. For many of the standard applications concerned with handling records there are packages with a proven record of use in the business environment. The profession would do well to exploit this experience, but there are a number of limitations to what is available. The selection process must always be a combination of professional judgement based on understandable information, just as the final purchase will be a compromise between idealised need and automated functionality.

These principles apply whatever the package being selected. Ultimately the purchaser has to make a commitment; a commitment not only to expenditure but also to an effort of understanding. This allows the suppliers to recognise, and contract to provide, appropriate software. Good free advisory services can prepare the user for what is to come, but the selection process as outlined in this paper can and should utilise unbiased provision, bought, ideally from organisations in the library and information service area.

Even then, when the marriage of application and software has been arranged, there is much work still to be done to make the relationship successful.

Organisations in the United Kingdom involved in services for software evaluation

ASLIB, THE ASSOCIATION FOR INFORMATION MANAGEMENT,
INFORMATION HOUSE, 26-27 BOSWELL STREET, LONDON WC1N 3JZ. TEL: 01-430 2671.

Contact: Stephen Flood

Providing information services, training, publications, research and consultancy to international members and non-members involved in information management. Current services include library of trade literature on software and regular user experiences in publications such as Program and Aslib Information.

LIBRARY TECHNOLOGY CENTRE, POLYTECHNIC OF CENTRAL LONDON,
309 REGENT STREET, LONDON W1R 8AL. TEL: 01-580 4562.

Contact: Mary Rowbottom

Demonstration and free advice on library automation packages. Maintain database of software packages. Publish experiences of users in various journals. (Funded by the British Library Research and Development Department.)

MICROSYSTEMS CENTRE NATIONAL COMPUTING CENTRE,
11 NEW FETTER LANE, LONDON EC4A 1PU. TEL: 01-353 0011.

Contact: Philip Virgo.

Information, training, publications and consultancies for business computer users. Self-funded. Directories of hardware, software and training produced monthly from extensive databases. Reviews and trade literature being collated.

EUSIDIC (European Association of Information Services),

P.O. BOX 429, LONDON W4 1UJ. TEL: 01-546 7968.

Contact: Helen Henderson.

European organisation concerned with automated bibliographic activities. Has assembled a database of software use in Europe which is to be made available on-line.

LEARNED INFORMATION LTD.

BESSELSLEIGH ROAD, ABINGDON, OXFORD.

Have compiled an international register of experts willing to review microcomputer software. Copies of software provided to perform practical evaluation, subsequently published in Electronic Library.

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IFLA GENERAL CONFERENCE, CHICAGO

Division: Management and Technology

Section: INFORMATION TECHNOLOGY

1985

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EXPLOITING TECHNOLOGY TO BUILD A CANADIAN LIBRARY AND INFORMATION NETWORK

by

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K E Y W O R D (S):

electronic library network

information network

Open Systems Interconnection (OSI)

National Library of Canada

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ABSTRACT

This paper gives an overview of the strategy for the development of an electronic decentralized nation-wide library and information network in Canada and its status after five years of development. The technical basis for the network development is Open Systems Interconnection (OSI) Reference model, approved by ISO and CCITT to allow different makes and sizes of computers to interconnect and intercommunicate. The development strategy is explored in terms of application protocol development, pilot projects to test protocols, the dissemination of the protocols, and the advisory structure in place for the resolution of technical and policy issues.

1.0 Introduction

This paper is intended to give an overview of the strategy for the development of an electronic decentralized nation-wide library and information network in Canada and the status of that development. The ultimate purpose of the network is improved resource sharing within the library and information community.

In 1977, the former National Librarian, Dr. Guy Sylvestre, directed a review of the role of the National Library of Canada (NLC), culminating in the publication of The Future of the National Library of Canada[1].

In the course of the extensive consultations undertaken during this review, it was determined that a centralized network for Canadian libraries was undesirable, and that new developments in high technology and telecommunications promised the technical possibility of developing a nation-wide network with a decentralized configuration.

In 1975, NLC acquired the DOBIS system to maintain an integrated, on-line, national data base (including Canadian union catalogue files, source files from the NLC and from national bibliographic agencies in other countries) and to provide a bilingual, shared cataloguing system for federal government libraries. The data base presently consists of over three million records and supports seventeen shared cataloguing participants, and over one hundred search-only customers. The DOBIS system runs on an IBM machine and uses IBM's 3270 protocol. Search-only customers can access the system via ASCII conversion software. During the review of NLC's role it was determined that DOBIS would be

a major, but by no means the only, node in the Canadian library and information network.

Some of the reasons leading to the conclusion that a centralized network approach ultimately would not be workable in Canada were, and are, as follows:

(a) Canada is a large country geographically, but has a small population. Hence there are vast distances between many of its urban centres where the majority of libraries are situated.

(b) The library community consists of institutions belonging to the public and private sectors and is supported by a plethora of municipal, provincial and federal jurisdictions.

(c) The library community utilises a wide range of different sizes and types of automated systems, including a large bibliographic utility, UTLAS (now owned by a multi-national company, Thompson International), and 150-200 individual or shared computer systems. It also has many smaller libraries without automated support.

(d) The automated systems operate in one or other of Canada's two official languages, or in both.

(e) Trends in computer technology are seen as being toward distributed processing, or standalone processing supplemented by downloading of data from multiple sources.

(f) The union catalogue is de facto decentralized in Canada, in that part resides on DOBIS, part on UTLAS, and some on emerging provincial/regional systems.

(g) Potential network members include not only libraries, but also users and service providers from sectors such as publishing,

information retrieval, and similar information creation, storage and distribution centres.

(h) A nation-wide network must build on existing systems to be economically justifiable.

(i) Regionalism is a strong fibre in the national fabric, and local autonomy combined with national resource sharing opportunities is seen as the most desirable and workable basis for a nation-wide network.

(j) North-south links with U.S. service providers will continue to exist to supplement Canadian resource sharing arrangements.

2.0 Open Systems Interconnection

In 1979, the staff within the NLC began an investigation of the technical feasibility of developing a decentralized network. In 1981 this project group became the permanent Office for Network Development in the NLC.

In the late 1970s, international standards bodies achieved a major breakthrough by devising a conceptual model for a series of standards, so-called protocols, which, when developed and implemented, would allow different makes of computers or terminals to connect and communicate with other computers. This conceptual model is called the Open Systems Interconnection (or OSI) Reference Model[2], and is the model adopted in principle by the NLC in 1980, as the most likely technical strategy by which the decentralized nation-wide library and information network could be achieved. The OSI model consists of seven layers of standards in which each layer is dependent on the one below it. The standards for the first six layers of the model are independent of

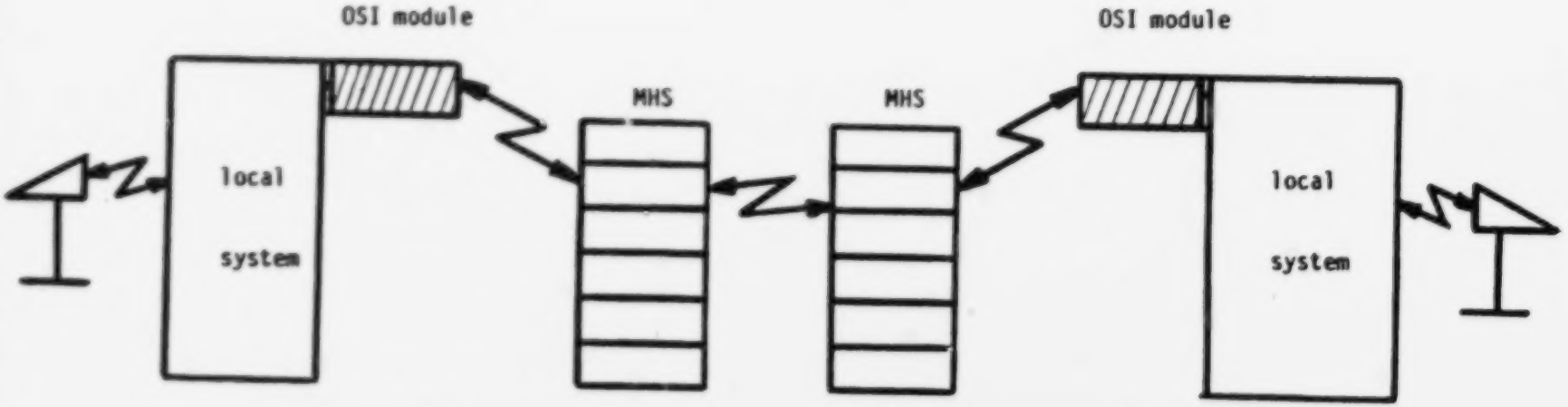
the data being transmitted. Only the seventh layer, the applications layer, must be developed specifically for each application.

OSI is independent of the hardware and software being interconnected. The model also applies to manual as well as automated processes, and furthermore, the model is based on the assumption that manual and automated systems will co-exist in networks.

The designers of the OSI Reference Model initially assumed that independent systems would use real-time, connection-oriented communications facilities to interchange data, that is, that the two computers would need to be physically connected at the time exchange of data took place. This assumption meant that every system was required to implement a substantial set of standardized functions before application-specific data could be exchanged. Now extensions are being made to the OSI Reference Model to allow for connectionless (or message-oriented) communications procedures to permit automated applications to exchange data by using intermediary store-and-forward (electronic mail) systems and services, such as the recently standardized message handling services (MHS)[3]. Connection-oriented and connectionless-oriented communications are shown in Figure 1.

There are numerous technical subtleties and cost implications associated with connection-oriented and connectionless communications. Since the range of functions that must be implemented on the host computer in a connection-oriented application is much greater, the effort and cost are considerably larger than in a connectionless implementation. Communications costs will be higher in the

a) Connection-oriented - single session per transaction.



b) Connectionless or message-oriented - separate sessions to complete a transaction.

Figure 1 - Two Modes of Interconnection

connectionless environment since applications must purchase the store-and-forward services provided by the intermediaries. Ease of implementation and more limited hardware and software requirements make connectionless applications more attractive to institutions with restricted resources. Apart from these considerations, applications such as book acquisitions and interlibrary loan are not amenable to real-time operation, since they require human intervention before a response can be provided to a request received from a remote system. Since the individual will need time to verify availability of the requested item, the real-time response required in a connection-oriented environment is impossible. These considerations will probably dictate that the connectionless mode will predominate as libraries in Canada gradually implement the application protocols which are currently being developed and tested jointly within the NLC's network program[4].

The greater development emphasis on connectionless protocols over connection-oriented ones in the Canadian network program differs from the connection-oriented protocol development of the U.S., the Linked Systems Project (LSP). This difference in emphasis arises, no doubt, from differences in approach to network development in the two countries. In Canada, a vast and sparsely populated country, we were concerned from the beginning to build a network by developing protocols which would serve all types and sizes of libraries and bibliographic utilities and that would link library systems with systems in related sectors such as publishing and information provider. By contrast, the American approach to date has been to

concentrate on the interchange of data between the Library of Congress (LC) and the three largest U.S. bibliographic utilities.

3.0 The iNet Trial

When I presented a paper to this Section on Information Technology at the 1982 IFLA Conference in Montreal[5], the NLC was co-ordinating the participation of a group of some sixteen Canadian libraries in the iNet Field Trial mounted by Telecom Canada. Canada has traditionally been a leader in telecommunications technology and Telecom Canada's iNet Field Trial was one of the first, if not the first attempt in the world to implement the OSI concept. As such, participating in the trial was an ideal opportunity for Canadian librarians to put theory into practice; to determine if protocols based on the OSI Reference Model could be used to make it possible for computers in Canadian libraries to communicate with each other and with other information sectors, and to share data in a way never before possible. The iNet trial proved this technical feasibility, and also provided us with the necessary practical experience to plan the next phase of network development. The results of the trial and the recommendations for future action have been published[6].

Faithful to those recommendations, the development of standard protocols for bibliographic applications has been the major thrust of the NLC's technical development since the end of the iNet Field Trial in 1983. Protocols are simply the standard specifications of the messages which need to be exchanged by two independent systems for a given application, the format of those messages, and the sequence in which they must be exchanged in order to achieve intercommunication. For example, the multi-part printed forms, which have been utilized by

libraries for so many years, represent a standard format for inter-library lending (ILL) or book order data, and the separate parts are submitted only in defined situations or sequences. The same forms are the basis for the data and messages that were incorporated into the ILL and Acquisitions (book order) protocols for automated systems. These protocols are adaptable to telex, electronic mail, microcomputers and main frames as well as manual systems.

4.0 Network Development Strategy

In promoting the development of a decentralized bibliographic network, the NLC is taking a four-pronged approach: the technical research and development of application level protocols are discussed in Sections 5 and 6; pilot projects, involving a variety of types and sizes of libraries and representatives of other related sectors, undertaken to test the prototype software resulting from the technical development, are reviewed in Section 7; dissemination of the resulting products through licencing agreements is covered in Section 8; and forums for network policy, service review and coordination are discussed in Section 9.

5.0 Technical Development

Technical protocol development is undertaken to provide the means by which different sizes and types of systems can interconnect and intercommunicate. In general, it should be noted that in the development of application protocols, the NLC utilizes, wherever possible, basic and enhanced telecommunications services available from the Canadian telecommunications common carriers to provide the lower layers of the protocols. In cases where these services were developed prior to the

acceptance of an international standard and hence are a non-standard, or pre-standard implementation, NLC still uses them, noting the need to adjust when the standard implementation becomes available from the telecommunications carrier. This strategy is possible because both the Canadian telecommunications companies are committed to implementing OSI standard protocols as they become available. By concentrating on application layer development, we significantly reduce the cost and the human resources required to implement a given application.

5.1 Task Group on Protocols

The NLC follows a well-defined set of procedures for standardizing application protocols. Since late 1980, the National Library's Task Group on Computer/Communications Protocols for Bibliographic Data Interchange (subsequently referred to as the Task Group on Protocols) has advised the NLC on international and national developments and strategies applicable to open systems interconnection in general, and to library/information applications in particular. The Task Group on Protocols' membership is broadly based and includes experts from the telecommunications, data processing, research, publishing and library applications sectors[7].

5.2 Protocol Development Strategy

Based on the Task Group on Protocols' advice, the NLC then undertakes the development of specific protocols through contracted research. The consultants usually produce three reports: a functional model, a service specification, and a protocol specification. A functional model identifies the participants and the kinds of functions that are

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performed to carry out a specific library application - book order messaging, for example. A service specification defines in detail the kinds of messages that need to be exchanged to support the application. A protocol specification defines in extended PASCAL computer language the hardware- and software-independent computer instructions that must be executed to ensure that the messages will be exchanged in accordance with defined sequences and formats.

To foster application protocol testing and independent implementation, the NLC also contracts with consultants to develop a sample computer program or sample implementation software as appropriate for a given application. The sample program is written in a high level language, such as C, and provides facilities to "hook" the generic software into the operating systems and input/output handlers of various existing computer systems. Existing systems have the choice of using a sample program or of using only the protocol and service specifications to guide them in their implementation.

For each application protocol, the NLC is planning to conduct formal assessment tests with each system that implements each protocol to verify, to the extent possible, that the implementation conforms to the protocol specification and therefore can communicate with all other implementations. Standard procedures currently being defined within ISO will be followed by the NLC in supporting the protocol testing and assessment.

These procedures are being incorporated into the protocol test facilities developed at the NLC by its own staff and by contractors.

To enable a library or other institution that lacks an existing automated system to participate in protocol pilot projects and evaluation, the NLC has contracted for the development of prototype protocol implementations when appropriate. In addition to the capabilities provided in a sample program, prototype implementation software includes data creation, editing, and storage and retrieval facilities. It represents a complete standalone system that is developed to run on a particular microcomputer supported by a specific data base management system and is hardware and software specific.

6.0 Application Protocol Functions

Each application level protocol provides the end users with a set of functions that can be invoked to instruct application programs resident on the local and remote hosts to take a given well-defined action. The application layer of OSI actually consists of two sub-layers. The upper sub-layer consists of messages specific to a single application. The lower sub-layer consists of generic applications which are building blocks for the upper sub-layer. For example, data will need to be transferred from system to system by invoking the search and transfer protocol (a building block protocol) for ILL functions and book order functions as well as for cataloguing. The NLC is developing both single application and generic application protocols (see Figure 2).

The following sections contain brief descriptions of the kind of functions that users will be able to execute on systems that have implemented the individual application protocols. Except for file

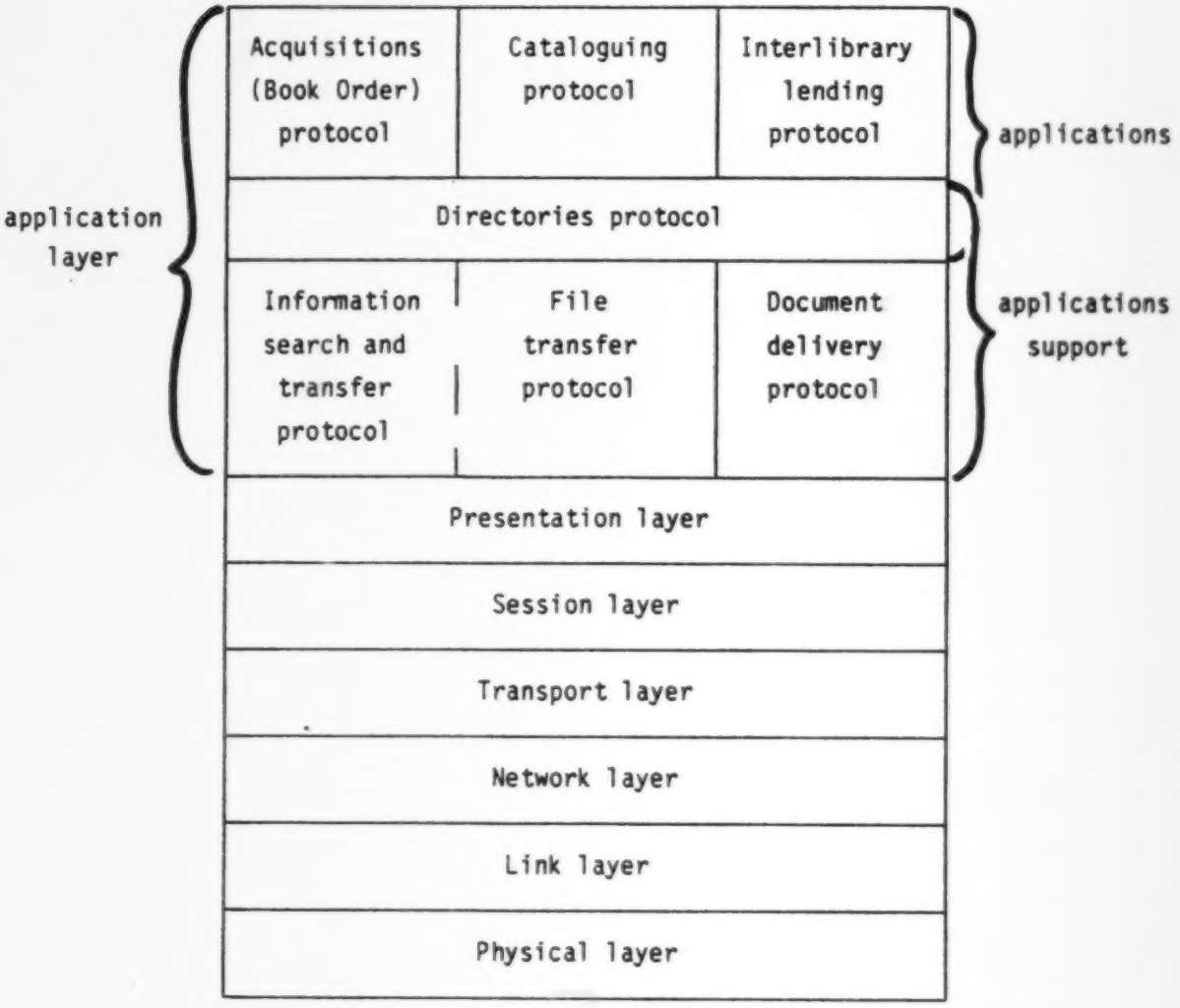

Figure 2: The two sub-layers of OSI application level protocols

transfer, all the other protocols developed by NLC to date are message-oriented and rely on connectionless communications support. See Figure 3 for the status of each protocol development project.

6.1 Single Application Protocols

6.1.1 Interlibrary loan

This protocol allows users to exchange messages such as ILL requests, overdue notices, cancellations, recall notices, extension requests, etc. among participants. The content of the messages used is faithful to the data element directory for interlibrary loan developed by ISO/TC46/SC6/WG1. This directory is now a draft international standard (ISO/DP8459/1) and is expected to become a standard in 1985. Furthermore, the syntax of the data elements is based on the Guidelines for Trade Data Interchange developed by the United Nations Economic Commission for Europe[8]. We will change this syntax if and when there is agreement on an international standard syntax.

Ten institutions are currently testing and evaluating the protocol which has been implemented on a standalone IBM PC workstation. Any changes to the protocol identified as a result of the evaluation will be made in Autumn 1985. Future enhancements will include the incorporation of the search and transfer protocol to allow automatic form filling from different data bases.

6.1.2 Acquisitions

The acquisitions protocol was modelled closely on the ILL model. It will allow libraries to submit purchase orders, return requests,

PHASE / PROTOCOL	1 APPLICATION MODEL	2 SERVICE SPEC.	3 PROTOCOL SPEC.	4 SAMPLE PROGRAM	5 PROTOCOL ASSESSMENT TESTING	6 PROTOCOL IMPLEMENTATION	7 PILOT PROJECT
FILE TRANSFER							
VERSION 1	Used ISO prel. version Mar. 82	Apr. 82	Aug. 82	Mar. 83	May 83	Jan. 84	-
DOBIS	-	-	-	-	-	-	Apr. 84
DOBIS/MRDS	-	-	-	-	-	-	Oct. 84
VERSION 2	-	Jan. 84	Mar. 84	May 84	TBD*	TBD*	TBD*
ILL							
VERSION 1	iNet experience	Mar. 83	June 83	-	May 84	Sept. 84	Jan. 85
VERSION 2	-	July 85	Aug. 85	-	Sept. 85	Sept. 85	-
ACQUISITIONS							
VERSION 1	Dec. 83	Feb. 84	Mar. 84	Oct. 84	Mar. 85	June 85	Nov. 85
VERSION 2	-	Oct. 85	Nov. 85	Nov. 85	Dec. 85	Dec. 85	-
DIRECTORIES	Mar. 84	Feb. 85	Feb. 85	June 85	July 85	Aug. 85	TBD*
SEARCH AND TRANSFER	Dec. 84	Feb. 85	Mar. 85	July 85	TBD*	TBD*	TBD*

* TBD = to be determined

Figure 3 - NLC protocol development schedule

claims, etc. to publishers and booksellers and receive machine-readable invoices and status reports from them. The test version of the protocol specification has been completed. Implementation of it is completed on one machine and underway on three others. A pilot project to test the protocol in an operational environment with publishers, book wholesalers and libraries will begin in 1986.

6.2 Generic Protocols

6.2.1 File transfer

In the particular application the NLC has done to date, the file transfer protocol supports the on-line submission of search requests and the subsequent transfer of MARC records to the requesting host systems. This protocol has been implemented on a variety of computers by individual institutions. The technical implementations of the protocol were completed by the NLC on its IBM computer, the Université du Québec on a CDC VAX, the University of Waterloo on a Geac, and Carleton University on a Honeywell in early 1984.

A pilot project began in late 1984 for searching, creating a file and transferring the file of records from NLC's MARC Record Distribution Service and from DOBIS to the other three institutions' systems. The pilot project will be completed in July 1985.

6.2.2 Search and transfer

Work on the search and transfer protocol began in September 1984. This protocol will complement file transfer by enabling users to search on different source data bases and then transfer, a record at a time, to applications such as interlibrary loan, acquisitions and cataloguing. A slightly expanded version of the American information

search and retrieval protocol (NISO, Z39.50) draft standard will be implemented.

6.2.3 Directory service

Implementation of the directory protocol will enable users to determine what services are available in the network from which organizations and under what conditions. If one uses the analogy of a library, the catalogue indexes what is available in the library through one or more access points, and provides information as to where it is to be found, conditions of its use, etc. In an open network it is also essential to provide an index of what data bases and services are available in that network, the terms and conditions of their use, hours of service, etc. The directory service protocol provides for these functions. It assumes that the directory data base will be distributed across many systems with minimal replication of records and provides functions which will permit users to effectively query and update distributed data bases. It also defines some initial application management routines and will provide participants with an introductory view of distributed application statistics gathering and trouble shooting. This protocol will incorporate the search and transfer protocol as well. A model of this protocol is currently being implemented on a SPECTRIX multi-tasking microcomputer, but it is expected that this complex implementation will remain in a laboratory environment for at least another year.

6.3 Use of Protocols on Local and Remote Systems

To date implementation and testing strategy has concentrated on interconnecting remote and independent systems. However, as the concept of

OSI and our understanding of it mature, it is becoming evident that the protocols could be equally valid for systems interconnections over local area networks. Figure 4 provides a schematic of a local area network which links a variety of applications running on standalone microcomputers. The local area network could in turn be linked to other systems using the applications level protocols. Development of prototype linking of systems on a local area network is presently being investigated at NLC, but is unlikely to be implemented until the technology is more mature.

7.0 Pilot Projects

To assess the impact and utility of a given application protocol, the NLC has established a number of protocol Development Advisory Groups. Group membership in each case consists of a range of bibliographic and information interests represented by specific institutions able and willing to participate in a test implementation of a specific application protocol. The group participants are screened to the extent practicable for their ability to represent the application requirements of libraries or other information sector needs and viewpoints, such as those of academic library, public library, publisher, bookseller, etc. as appropriate. Currently, NLC has Development Advisory Groups for file transfer, ILL, acquisitions and directories applications. The size of these groups varies from four to eleven members. The pilot project participants review the service and protocol specifications, draw up evaluation criteria to determine how well the protocol meets the requirements of users within the pilot project, and its utility in an operational environment. Following completion of each pilot project (which normally lasts about six

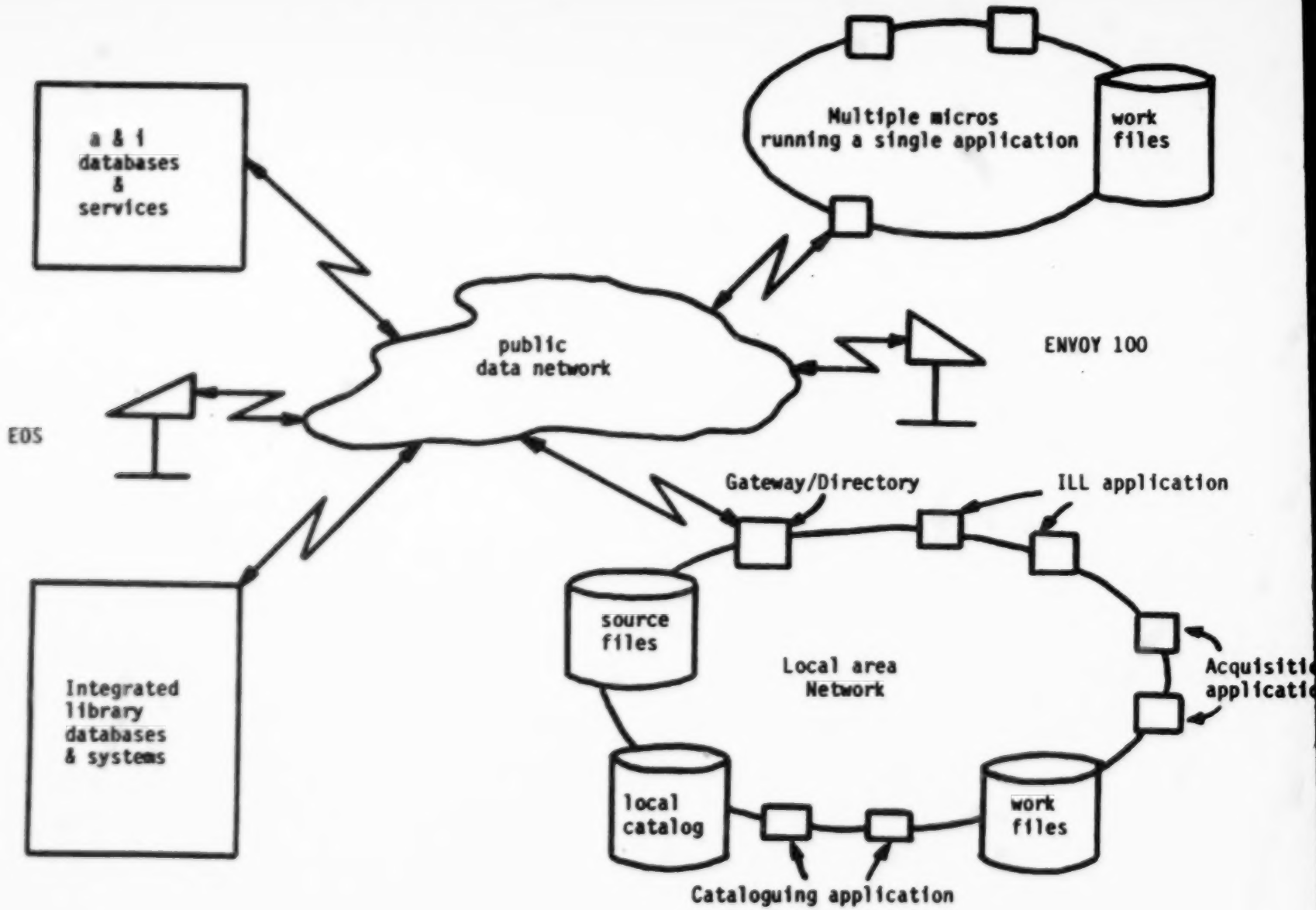

Figure 4 - Potential Application Interconnections

months), the NLC contracts for necessary revisions and enhancements to each application protocol prior to its wide dissemination. It may then add additional protocol modules, as appropriate. See Figure 3 for the schedule of pilot projects.

8.0 Dissemination of Protocols

The NLC will foster the wide acceptance of OSI within bibliographic and related sectors by making the application protocols and sample programs available to any Canadian organization or private sector company that wishes to use them. To date UTLAS has received and plans to implement the ILL protocol. Geac has received all application level protocols as they become available, has implemented the file transfer protocol and is working on the acquisitions protocol. Several other Canadian private sector companies and individual institutions have requested their release as well.

Release of the protocol specification is on condition that the implementation of the protocol be tested against the testing programs developed under contract for the NLC, in order to ensure that all implementations can communicate with each other. Once the testing is completed, the vendor or institution has a royalty-free licence to market its implementation world-wide. These licencing agreements are currently being finalized. Thus, we foresee commercial software firms as well as libraries contributing to OSI implementation for library applications. Policies have been developed for distribution of application-specific software developed for specific machines for pilot projects. These policies will also involve distribution

licences to private sector software houses on a non-exclusive, royalty-free, basis.

Requests for NLC protocol specifications have been received from non-Canadian institutions. Policy on licensing to non-Canadians is still under discussion. A major complication in this policy is the need for testing those non-Canadian implementations - a workload NLC does not feel it can or should undertake.

The NLC and the LC issued a joint press release in May 1985 stating their intention to work toward compatibility of their respective protocols[9]. Following this press release discussions have taken place between the two organizations resulting in agreement in principle to work through the respective national standards bodies to achieve common North American standards for the applications protocols.

9.0 Forum for Policy and Service Coordination and Review

From the beginning of the development of the decentralized library and information network, the NLC in its role as facilitator and coordinator of network development, has fostered cooperative development, through close consultation with all types of potential network participants.

At the policy level, the National Library Advisory Board created three committees of the Board in the early 1980's to deal with network policy issues as they emerged from the pilot projects and on-going development. The committees are appointed by the Board, meet twice per year, and have approximately twelve members each, representing

library, information provider, publishing, telecommunications and legal expertise.

The Bibliographic and Communications Network Committee is concerned with policy arising from the developing electronic network itself. That is, it deals with such issues as principles and guidelines for the network, copyright and ownership of machine-readable data, government telecommunications regulatory issues, contracts and agreements, licencing of protocols and software, data base service charges, etc.

The companion Resource Network Committee is concerned with policy issues of resource sharing within that network, for example, charging for interlibrary loans, collection surveys, conservation policy.

The Committee on Bibliography and Information Services for the Social Sciences and Humanities is broadly concerned with fostering the creation of Canadian bibliography, reference works, and machine readable data bases in these subject areas.

Reporting to the National Librarian is the Task Group on Protocols which, as already noted, is comprised of experts on various aspects of OSI and provides direction for technical development. It also meets semi-annually and has approximately fourteen members.

The Canadian Committee on Cataloguing is a long-established committee comprised of representatives of the two national library associations: the Canadian Library Association (CLA) and the Association pour

l'avancement des sciences et des techniques de la documentation (ASTED), and the NLC. This committee is responsible for setting bibliographic standards to be used by Canadian libraries and its Chairman is the Canadian representative on the Joint Steering Committee for AACR2.

The Canadian Committee on MARC is a committee responsible for revisions to the Canadian MARC format (CANMARC). This Committee is also composed of CLA, ASTED and NLC members. In addition the major Canadian bibliographic utilities/consortia are also represented.

During the iNet trial, the Bibliographic Common Interest Group was formed and was very active as a review group for all pilot project and development group work undertaken by them in concert with the NLC. This Group is now defunct and there are plans to replace it by a group representing regional coordinators and/or institutions heavily involved in implementing or testing protocols. This new group is intended to act as a review forum for issues arising out of the Development Advisory Groups and to deal with operational and service issues pertaining to implementation of a decentralized network. Criteria for its membership are presently under review.

10.0 Conclusion

By taking this four-pronged approach to library network development the NLC is optimistic it can develop a coordinated library and information network in Canada that will provide participants with a wide choice of interconnected and intercommunicating systems and services which will give both the advantages of local autonomy and of

economic nation-wide resource sharing. The enthusiasm with which the developments to date have been received by the library community bodes well for their wide acceptance in Canada.

In this age of rapidly changing technology the NLC sees the active involvement and support of the government, telecommunications and high technology sectors as essential to the ultimate success of the library and information network in Canada. Close cooperation with these sectors will ensure that they are, and remain aware of the evolving needs of the library community, and of the substantial contribution it can make to the successful evolution of the "information society". Already, during the past four years of network development, we have witnessed within these sectors increased awareness and respect for libraries and for the expertise of the library profession. It is NLC's conviction that in the emerging information society, the role libraries will play will be at least partially determined by a perception within these various sectors that libraries can provide leadership in using technology to serve the cultural and industrial objectives of that society. Conversely, in order to ensure that libraries can take advantage of the most recent technological developments where these will result in more effective provision of network services, it is essential that they are continuously in touch with the latest developments and trends in the telecommunications and high-technology sectors.

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Division: Management and Technology

Section: Information Technology

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LINKED SYSTEMS PROJECT IN THE UNITED STATES

by

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WASHINGTON, DC, USA

K E Y W O R D (S):

computer-to-computer
communication
telecommunication protocols
Open Systems Interconnection
Linked Systems Project

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90

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Abstract

Linked Systems Project in the United States

Sally H. McCallum

The Linked Systems Project (LSP) is developing computer-to-computer links between the following systems in the United States: Library of Congress, Washington Library Network, Research Libraries Group, Online Computer Library Center. This project opens up a great number of possibilities for sharing data that have until now been impossible because of the incompatibility of computing machines and their operating systems. The LSP links conform to the standards for Open Systems Interconnection (OSI) being developed by the International Organization for Standardization (ISO). The first applications being implemented are Record Transfer, for moving files among sites, and Information Retrieval, for intersite searching of data bases, both of which will support the building of a joint nationwide authority file. The links are not limited to use in the authority file project, however, and will be extended for exchange of other forms of data.

This article describes the applications, the underlying telecommunications, and the specific use of the facilities.

LINKED SYSTEMS PROJECT
in the
UNITED STATES

INTRODUCTION

For the last ten years there has been interest worldwide in forging practical telecommunications standards that make it possible for dissimilar computer systems to exchange data. Initial interest stemmed from a computing environment in which terminals that were relatively "non-intelligent" were connected to mainframes, where large stores of data were kept and accessed. It seemed necessary to develop communications standards so the mainframes could both continue to be developed according to innovative designs with different hardware composition and operating systems, yet with a standard interface that would enable the machine to communicate with any other machine that implemented the standards. With such computer-to-computer links, users at terminals would have access to data on their own mainframe computers, and, through that computer to other mainframes. Today, producing a standard, economical method of system-to-system communication is even more important because formerly non-intelligent terminals are themselves becoming computers, in the form of micro computers.

The response of the International Organization for Standardization (ISO) to this need was to establish several subcommittees within the ISO Technical Committee 97 (TC97), Information Processing Systems, in 1978 to begin work on required telecommunications standards. The approach taken by ISO was to identify functionally the processes that needed to occur and types of information needed to support those processes. From this analysis a communications model was formulated that allows flexibility in building communications specifications and design.

In the United States library community the development of these standards has been closely watched because of the emerging network configuration. There have been several large systems on which bibliographic data has been collected for many years--the Online Computer Library Center (OCLC) began operations in 1972, the Washington Library Network (WLN) in 1974 and BALLOTS, the precursor of the Research Libraries Information Network (RLIN), in 1975. If there was to be "universal" sharing of bibliographic data in the United States, it was going to be necessary to implement a cost-effective method of interconnection of dissimilar systems.

Thus the United States work on implementing system interconnection, called the Linked Systems Project (LSP), is taking place in a well developed network environment (Figure 1). The four initial members of the project, the Library of Congress (LC), the Research Libraries Group (RLG), WLN, and OCLC, each have established bibliographic systems with record creation, file building and search and response systems that differ significantly, yet each of which is based on the data content and content designation found in the MARC record.

The discussion of LSP is in three parts. The first gives a brief description of the specific project that the initial implementation of the computer-to-computer links will support. The second gives a summary of the telecommunications standards used; and the third describes how the applications are being implemented.

LSP Initial Application

The first application to be implemented in the Linked Systems Project is the building of a joint authority file. LC has maintained a very large, consistent authority file of names, places, corporations,

conferences, and uniform titles for many years as a necessary component of the catalog to its immense holdings. Because of the comprehensiveness of the authority file, it has been very useful to libraries across the country. Thus it has long been recognized that if the headings from other libraries in the United States could be made consistent with the LC file and then shared, many libraries, including even LC could further benefit. The barrier to this type of cooperation was the lack of timely access to the LC file and inability to quickly add records to the file. Nevertheless, LC began a cooperative program, called the Name Authority Cooperative (NACO) in the late 1970s, using the LC publications such as the National Union Catalog (NUC) and Name Authorities for file access and the United States Postal Service as the "transmission" mechanism for contributions. That program has grown from a single participant, the United States Government Printing Office (GPO), in 1977, to 35 participating libraries in 1985.

Since LC began conversion of all LC name authority records into machine readable form in 1977, there has been planning carried out by LC and other institutions, supported by the National Commission for Libraries and Information Science (NCLIS) and the Council on Library Resources (CLR), to make possible online access and more timely input to the growing NACO file.

The NACO program for data base building was thus taken as the first application to use the system interconnection facilities of LSP because of obvious mutual benefits. LSP could at last provide the timeliness of access and contribution needed for NACO to operate in an efficient manner; whereas NACO provided LSP a well-established cooperative effort with which to work.

Building the LSP links divided into two parts: the first part is a communications facility conforming to ISO standard and neutral to the type of data it transmitted; the second is for facilities that use existing applications on each system to enable users to carry out the intersite activities required for the NACO project.

The LSP communications facility, called the Standard Network Interconnection (SNI) is the part of the system that takes messages from an application and delivers them to an application on another computer. When LSP formally began in 1979/80 the International Organization for Standardization (ISO) was at last beginning to formulate the Open Systems Interconnection (OSI) Reference Model which, with accompanying service definitions and protocols, is yielding a standard foundation for communication between unlike computers and operating systems. The ISO OSI model divides the functions that need to be performed for communications into a series of layers implemented at both communicating sites. Each layer provides services to layers above it in the hierarchy and exchanges information with its peer layer in the system with which it is communicating (see Figure 2). A brief look at the layers with their principal functions will make these activities clearer.

For a message to be sent from applications in machine A to machine B, the message is passed first to the top or seventh layer of machine A's OSI protocol environment. This application layer arranges the message into an agreed upon form that can be understood by the corresponding application layer on machine B. The message in its new form is then passed to the presentation layer in machine A where character code conversion, compression, encryption, or other representational transformations take place.

Then the data is passed to the session layer which adds information pertaining to the requirements the two computers have agreed upon to assure that individual messages received and sent at each computer remain correctly associated with each other, and do not become mixed with messages pertaining to another dialogues. The session layer also enforces the communication rules such as duplex, simplex, etc., and provides for session recovery in the case of temporary lower layer network failure.

The message then passes through the lower four layers which are, going down from four to one, the transport, network, data link and physical layers. These four layers are more concerned with moving the data that has been passed to it from the upper three layers and the application, accurately and efficiently across the telecommunications medium. Transport provides error detection and recovery and a number of other communications system functions such is resilience, security, multiplexing; while the network layer routs and segments messages, the data link layer exchanges these segments, and the lowest layer, the physical, provides for the transmission of the individual bits.

At the site of machine B, the message from machine A is received by the physical protocol layer, and the message is reassambled, validated, secured, routed, and converted as it moves up through the corresponding OSI layers on machine B. The message is finally passed to the application at machine B for processing.

This process, while long to explain is a quick and simple process that assures accurate and efficient discussion between to computers that essentially speak different languages.

LSP's Standard Network Interconnection

A few short-cuts were taken in the LSP implementation of OSI by assuming certain items such as encryption would not be required and thus not supporting it. In addition, since the project had progressed to programming our Standard Network Interconnection a year ago and design was completed a year and a half ago, it has been running ahead of the ISO standards. Our session layer conforms to a close-to-final draft of the ISO session protocol specification and our Presentation and Application layers are very simple functionally, since only general specifications for their contents were available when the LSP designs were finalized. Next steps in the LSP project will be to bring each of the upper layers up to the ISO standards as those standards become final.

Standards for a part of the application layer, that part dealing with specific library oriented applications such as interlibrary loan, are under development both nationally and internationally. These specific application protocols are not being written by the computer standards group, but by the group responsible for documentation standards, Technical Committee 46 in ISO.

APPLICATION INTERFACE

Two basic application capabilities, Record Transfer and Information Retrieval have been implemented in LSP with the following general requirements as a guide:

1) The system should allow both record and file transfer in online background mode, and online interactive search and retrieval of records.

2) The system, while initially supporting authority record exchange and file building, should be generalizable to any type of record.

3) Users at each site should be able to use local search command syntax, in so far as possible, for intersystem searches and should see results in their usual local screen formats.

4) Records retrieved as a result of searching, should be sent in a format that makes it possible to easily incorporate them into the receiver's file if desired.

In the description below, Record Transfer and Information Retrieval are first described, then the functional uses of these facilities for NACO file building -- record contribution, record distribution, and intersystem searching -- are described.

LSP RECORD TRANSFER

Record Transfer is the LSP facility used to move records in online mode between LSP facilities. This record or file transfer operation can take place automatically in a background mode. Any type of record and any number of records can be sent using the Record Transfer mechanism. Record Transfer operates in the following way (Figure 3). Two sites agree to exchange a certain type of records. Those records are stored at each site on a file that allows sequential access to the records, called a queue. When one agency wants to obtain records from a specific queue at another site, a connection is established and a Record Transfer request is made. The Record Transfer request tells the target site the queue from which records are requested and the number of sequential records that are desired starting with a specific position in the queue. The request may be for one or for many records. The target site then sends the requested records.

Use of LSP Record Transfer for the NACO Project

LSP Record transfer is used to enable all NACO participants to have timely access to the NACO file and to be able to contribute records to the file in an efficient manner--two key requirements for the success of the NACO project. The NACO project is structured such that one site holds a copy of the NACO authority file that is designated the "master file." LC, the system on which that file resides, has special responsibility for quality control and benchmark requirements. Copies of the NACO file are distributed to each of the participating utilities, WLN, RLG, and OCLC, by LC. This enables NACO contributors to carry out their work totally on the utility to which they are a member and allows the utilities to maintain the types of bibliographic/authority record links needed for authority control.

Thus for the NACO project, the LSP Record Transfer capability is used to send records being contributed to the NACO master file to LC and to distribute copies of records that have been added to the NACO master file to WLN, RLG, and OCLC. The following describes the NACO process after the implementation of LSP (see also Figure 4, where RLIN is used as an example to illustrate the process).

Starting with the NACO participant's need for an authority record as part of its cataloging activity, the use of LSP Record Transfer by NACO participants will work in the following way. A NACO participant searches the copy of the NACO file on WLN, RLIN, or OCLC. If a record for the heading is found, the participant uses the heading. If it is not found, or the NACO authority record on which it is found requires updating, the participant creates an authority record or updates the existing one on the WLN, RLIN, or OCLC system. The new or updated record automatically goes through WLN, RLIN or OCLC edit checks, and when it passes, it is placed on a special "contri-

bution queue" that each utility maintains of records ready for transfer to LC.

The LC computer automatically initiates Record Transfer connections at intervals throughout the day and selects records from the contribution queues at each LSP site. The records collected are then put through edit checks at LC. If the record passes, it is added to the NACO master file; if it fails, the record is discarded at LC. In both cases, a response record is created at LC and placed on a special "response queue." The positive responses contain very little except "approval" notification, the negative responses give the error conditions found by LC.

The response records are selected from the response queue at LC by WLN, RLIN, and OCLC on LSP Record Transfer connections automatically initiated by their computers at intervals each day. Each of these agencies informs the NACO participant of error conditions in rejected records. A rejected record, while purged from the LC system, will still reside on the participant's system in the form in which it was originally submitted. The participant can then correct and resubmit the record.

If a contribution record passes edits and is added to the NACO master file, it is simultaneously added to a "distribution queue", from which WLN, RLIN and OCLC daily request records via LSP Record Transfer for addition to their NACO file copies. The record is also sent by LC to its Cataloging Distribution Service for distribution via tape.

The records from the contribution and distribution queues are formatted into the USMARC communications format for transfer intersite. Those from the response queue are in a format specified in LSP documentation.

LSP INFORMATION RETRIEVAL

The second basic facility being implemented under LSP is Information Retrieval, used to support intersystem search and response sequences (Figure 5). Information Retrieval may be used for any type of search; the rules used to formulate the search are indicated in the application protocol message that contains the search. The format of the records returned is indicated in the response. The Information Retrieval facility allows the site that sent the search to instruct the site that received the search request to send back all records if there are not more than a specified number, to send back a specified number and a total count if there are less than a greater number; and to send back only a count if there are more than the greater number.

Intersite Searching in NACO/LSP

Information Retrieval can have a number of uses in the exchange of authority and bibliographic records, but there are several important ways the intersystem search capability will be used in the NACO project. The first is to search for records in the rich non-NACO resources that will reside on system. The NACO file is built by a select group of participants who have received special training and agreed to follow procedures to ensure high quality contributions. Other libraries on WLN, RLIN, and OCLC will find many of the headings that they need in the NACO file but when they do not, they may create authority records on their utility. These records form a resource of records that may be useful to build upon for a NACO participant. LC will also be using the search capability to assist in monitoring the file quality and in answering requests from participants.

The Search Query

Formulating the structure of intersystem searches was a difficult task that required first detailed comparison of searches on all systems and then development of an unambiguous syntax for the interchange of searches. There was agreement in LSP that the basic search systems already in place at each site would not be changed and local search command syntax would remain the rule for local system users. All local searches would be translated into a "neutral" intersite syntax before they were sent. The intersite form would then be converted to the local form required by the software at the site that received the search. This would minimize the impact on software at the LSP sites and on local users. The search systems of the three original participants, WLN, RLIN, and LC, were thus examined to determine the basic components of searches, and a search syntax was developed from that analysis.

LSP analysis indicated that the principal factor in a search is always the search "term" but any search system has a number of implicit and explicit "attributes" that are associated with the term(s) to indicate how the term is to be treated, etc. For example, the LC user command:

FIND s 'dog house'

defines a search for the term "dog house" with the following explicit attributes:

- single quote marks surrounding the terms indicate that the two terms are to be considered a phrase, appearing adjacent and in the order specified,
- "s" indicates the phrase must appear in a subject field in a record,

and these implicit attributes:

- the phrase may occur any place in the field or subfield that contains it, beginning, middle or end,

- the phrase does not necessarily constitute the complete field or subfield, i.e., there may be words following it in the field,
- the phrase is not truncated, i.e., "dog house" will not be a match.

For the LSP intersystem form of query it was necessary to identify all such attributes since they must be explicit in the intersystem query syntax. Two more basic search components were also needed and were added to the intersystem query syntax for this first application -- boolean capability and syntax for a search that qualifies a previous search.

A natural candidate for the syntax of the intersystem searches was Reverse Polish Notation (RPN), and the form that places operators after the terms on which they operate was selected. Using RPN, and defining the basic elements of a search as argument (a term and its attributes) and boolean operator, a intersystem search of the form "(dogs AND cats) OR pets" becomes "dogs cats AND pets OR", or in general terms:

$$\text{argument}_1\ \text{argument}_2\ \text{operator}_1\ \text{argument}_3\ \text{operator}_2.$$

A simple format for the search was developed that contains, in addition to arguments and operators, an indication of whether the search is a qualifying search and the name of the file to be searched at the target site.

The attributes and search characteristics defined for this first implementation of an intersystem search syntax are basic but cover most of the searches held in common by the implementation sites. A next step will be to expand the syntax to cover additional types of searches so that LSP sites can take advantage of less common search capabilities available only on one or two systems. This will require enhancement of local commands beyond that needed for local searches, but the enhancements can be compatible with existing user command syntax.

Another problem in intersystem searching is the mismatch, however slight, in indexing from site to site. There would be very little intersystem searching if the demand were made that exactly the same results were necessary on any two systems. The differences may be slight -- for title searches, one site may index the main title of a work and the its subtitle while another indexes only the main title -- or they may be more extensive -- a third system indexes the main title, subtitle, uniform title and, where applicable, the key title for a work. These differences had to be largely ignored in the intersite system, depending instead on educating the user about significant differences. Experience will show how troublesome these misfits will be.

Result Sets

In the Information Retrieval facility being implemented under LSP, initial "instructions" on numbers of records to return from result sets are given when a query is sent. Thus if a search is successful at the site to which the search is sent, the system that originated the search will receive back either the records, a count of the number of records in the result set, or both. By agreement in LSP, search response records are in full USMARC format, so that a record can be incorporated into the receiver's file if desired. USMARC is also the best common format for exchange between systems since each system has different internal formats and screen formats. After a result set has been established at the site of the search target, person who originated the search can ask to see records in the result set or may instead send a qualifying search. In the future there are a number of enhancements to this basic result set manipulation capability that can be included, such as the ability to request brief instead of full records.

FUTURE DEVELOPMENT OF LINKING

The above describes very briefly the basic OSI facilities we are implementing in the United States under LSP. Getting this first very large implementation completed has been an enormous task. The Library of Congress has completed its work and the other LSP participants will soon complete theirs.

During this implementation period, the computing and telecommunications environment has not stood still, so we are beginning to look at new ways to use what we have built. An obvious use of the link is to communicate with and between smaller systems, including micros. Another is to use standard message handling services provided by networks like Telenet and Tymnet when such is offered in the United States. Canada's work is taking advantage of such offerings in Canada at this time, and the United States is working with Canada on application layer protocol standards so that the standards will support both interactive applications, as is LSP, and remote operations applications that have been developed in Canada. In Europe, Norway has carried out extensive testing of OSI. As a result of this activity, ISO Technical Committee 46 has organized a Working Group in which Norway, United States, Canada, United Kingdom, Denmark and others are using their experience to develop international standards that will extend efficient communication worldwide in the information community.

Figure 1: COMPUTER-TO-COMPUTER LINKS BETWEEN LC, WLN, RLIN, AND OCLC

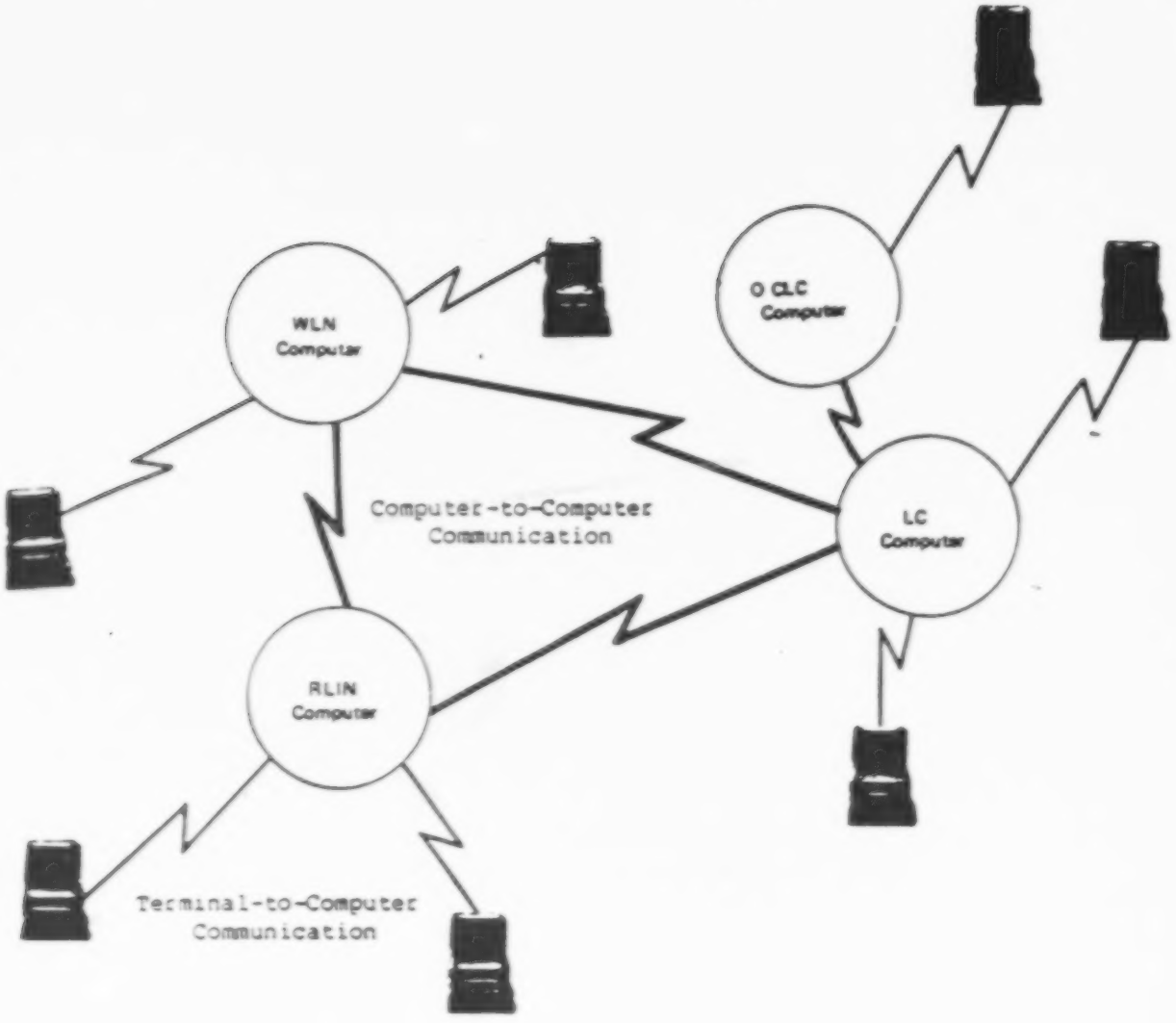

Figure 2: LAYERS OF THE ISO OPEN SYSTEMS INTERCONNECTION PROTOCOL

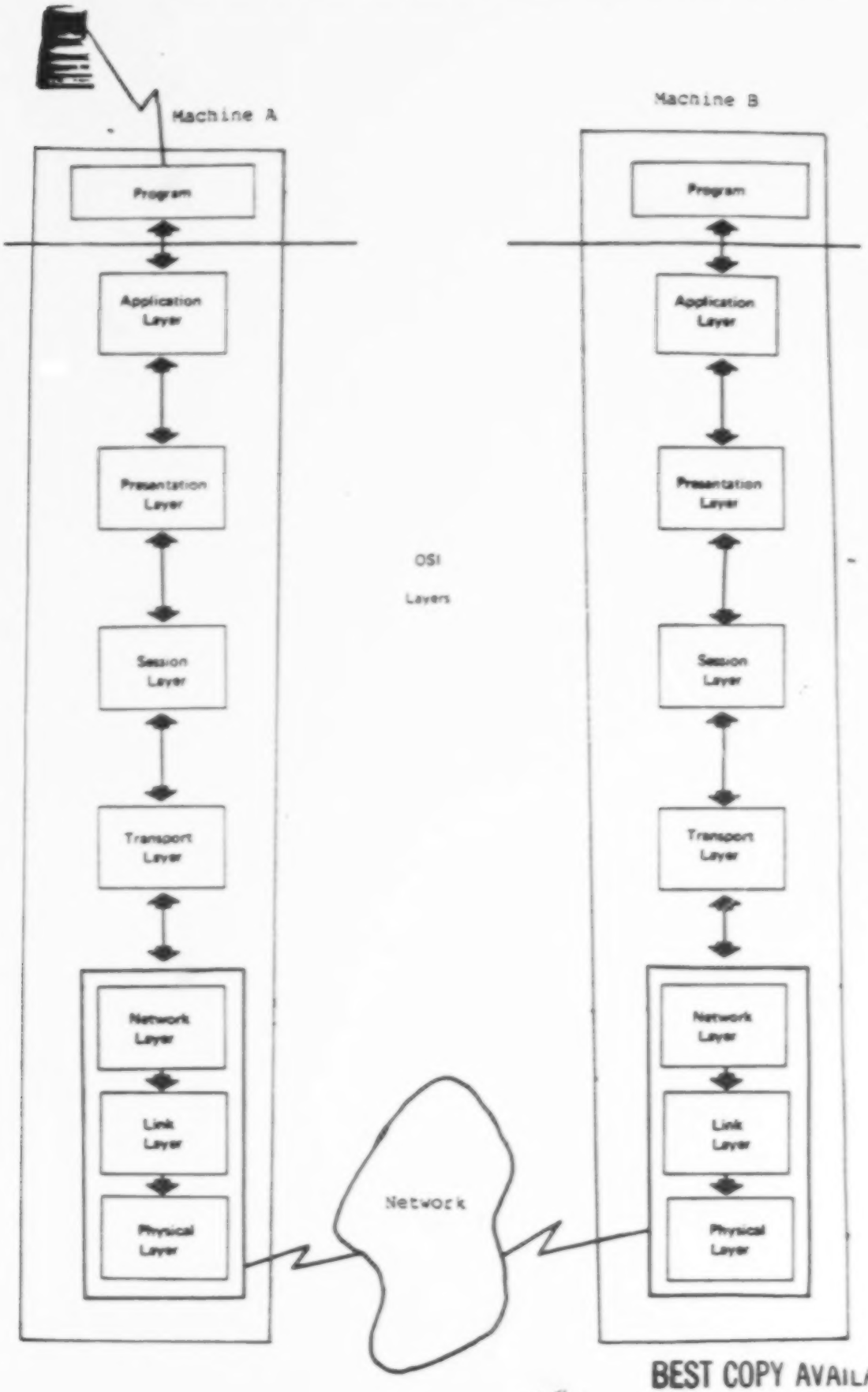

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Figure 3: EXAMPLE OF LSP RECORD TRANSFER BETWEEN OCLC AND LC

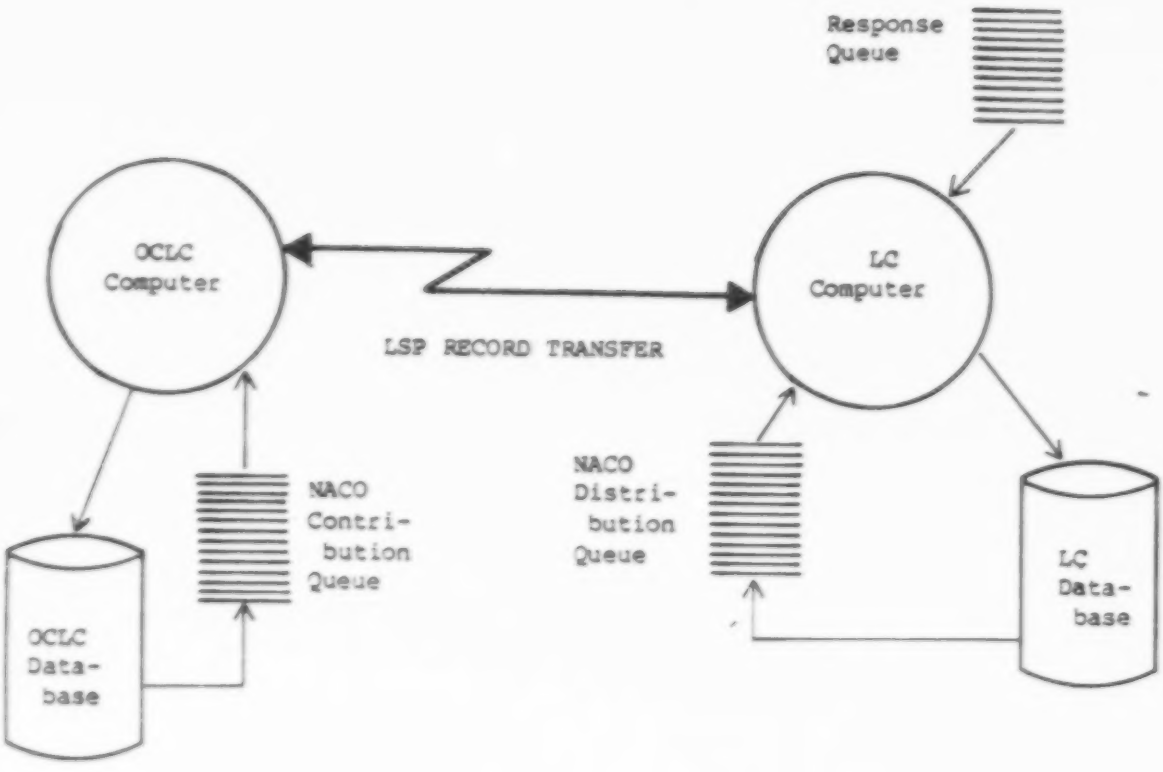

Figure 4: EXAMPLE OF RECORD CONTRIBUTION AND DISTRIBUTION FOR USER ON RLIN (the same process is followed for users on WLN or OCLC who search and input records to WLN and OCLC, respectively)

User searches NACO file at RLIN
NACO record found and no change required
User uses data
NACO record not found or change required
User creates and inputs record on RLIN
RLIN edit checks record
Record fails
RLIN sends message and rejects record
User corrects and resubmits to RLIN
Record passes
RLIN places record in record contribution queue
RLIN sends message to user
RLIN updates copy of NACO file
Reject response
Approve response
LSP RECORD TRANSFER: LC selects record from contribution queue
LSP RECORD TRANSFER: RLIN selects response from response queue
LSP RECORD TRANSFER: RLIN selects record from distribution queue
LC edit checks record
LC places responses in response queue
LC places record in distribution queue
Record fails
Record passes
LC discards record
LC updates master NACO file
RLIN System
Record Transfer Intersite Activity
LC System

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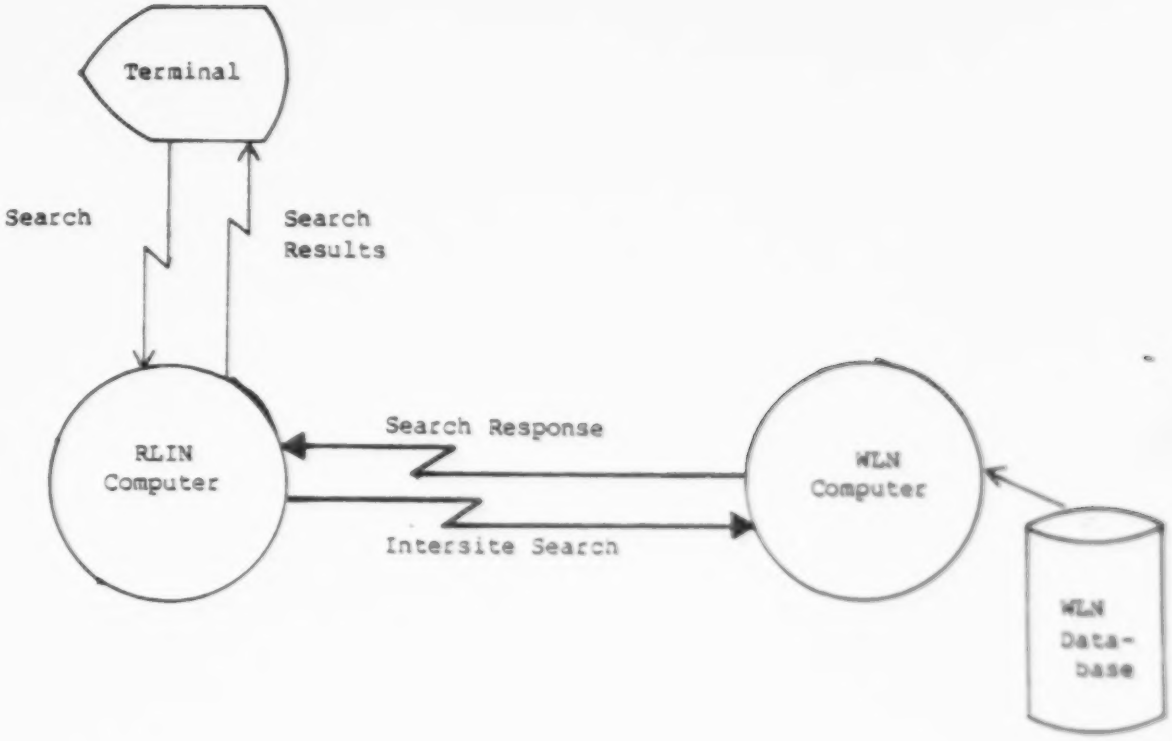
Figure 5: EXAMPLE OF LSP INFORMATION RETRIEVAL BETWEEN RLIN AND WLN



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ASSIMILATING THE MICRO: The Use of Microcomputers in Public Library Services

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S I I T O N E N

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Leena Siitonen:

Assimilating the Microcomputer: The Use of Microcomputers in Public Library Services

I. Introduction

This paper is a short exploration of the revolution and the realities of microcomputers. For most part, the discussion is general. As more libraries invest their resources in these types of devices, new, definitive patterns will undoubtedly emerge. The library community as a whole has yet to establish standards for the use of micros simply because they represent a new technology. This paper will draw upon the experiences of librarians both in developed and developing countries as examples from varying information settings to suggest possibilities for future considerations.

In this vein, the paper attempts a practical approach to microcomputer systems specifications for public libraries in order to elaborate on these requirements in terms of their implications for the library's microcomputer hardware and software.

II. Background

The development of information technology inmost developed countries has happened in past three decade. The diffusion of information technology was surveyed, in nine European countries, by the Organization for Economic Co-operation and Development (OECD) in the beginning of the 1980s. A statistical survey of Austria, Canada, Finland, France, Germany, Japan, Sweden, the U.K., and the U.S. was based on empirical case studies, econometric research using macroeconomic approach and a telecommunications traffic survey. Some of findings are reported here to depict the background of developed countries in terms of introduction, cost, and availability of information technology.

Each of the following factors was influenced by the rapid advance in information processing technology. However, the report stated, "it is clear that the influence exerted will depend both on the characteristics of the new technology and on the pace at which it is introduced. (OECD, p. 85)

Four impacts of the rapid development of advanced information processing technology merit particularly close attention. These are:

- the impact on factor productivity in information related tasks
- the impact on the elasticity of substitution between capital and labor in these tasks
- the impact of the relative price of information labour and capital
- the impact of changes in factor productivity on the relative price of the outputs of information-related activities, and the responsiveness of demand to output price changes.

The report stated that it was extremely difficult in practice to forecast diffusion rates for new technologies, but three items having a major impact on this rate could be identified. These were: familiarity, cost, and availability.

As the number of users of the technology increased, its capabilities were more clearly appreciated by potential users and the risks associated with purchase declined. The increasing familiarity of users with information processing technology contributed to accelerating diffusion rates in the 1970s and was expected to lead to more rapid diffusion of information hardware in the 1980s.

In regard to the cost, econometric studies suggested that diffusion rates for new technologies were highly sensitive to the purchase price and operating cost of the capital goods in which they were embodied. (See: E. Mansfield. Economics of Technological Change. New York, 1968.) The cost of information processing capital goods has been declining; and it seems reasonable to suppose that this decline will continue, though at a decreasing rate. This was because reductions in the cost of electronic hardware and software components have been the principal source of reductions in the cost of computing; but hardware and components now account for a relatively small part of the cost of operating a computer installation, often between 10 and 20 percent only. (See, e.g., B. Lamborghini and C. Antonelli, in: Microelectronics, Productivity, and Employment., Paris, OECD, 1981. ICCP Series, No. 5.) In contrast, the proportion of these costs attributable to software and services has been increasing; these are areas where productivity growth has been and will continue to be slow.

The increasingly widespread awareness, in the user community, of the potential of information processing technology combined with the declining user cost of this technology could be expected to lead to increases in diffusion rates. These increases may, however, encounter bottlenecks on the supply side. Particularly acute, in this respect, is the shortage of the trained manpower needed to make efficient use of the technology. In the long run, increases in earnings can be expected to stimulate increases in the supply of labor to those occupations but, until this occurs, personnel shortages may constrain the diffusion process.

The diffusion of information technology in developed countries has faced many problems which as such apply to the microprocessor industry. Peter Moll, in his extensive survey on "Should the Third World Have Information Technology?" (Moll, 1983) expressed "the belief that the main barriers to the availability of information in the Third World are the lack of financial resources and insufficient trained manpower." Moll looked at some projects to improve the infrastructure in Africa, financial considerations concerning the transfer of information technology and the problems of dependency. He also examined manpower problems and the attitudes of professional librarians towards information technology. Moll stated: "The problems of installing technology in Third World pale beside those of finding the financial resources and skilled manpower to maintain it in service."

Although suggestions that less expensive and complex approaches would be more useful were often rebuffed as almost insulting, Moll concludes that "Third world librarians appear to be less enthusiastic about information technology than many of the planners, decision-makers and visiting 'experts'." Most developing countries do not have the skilled staff and resources to set up their own highly technical and costly networks.

Dependency on distant data bases creates problems of document delivery, use of foreign languages, and provision of suitable training programs. Moll reports, however, that some developing countries have their own data bases, often as part of the international networks within the UN family. "Local and other appropriate material can be fed into a central computer, in addition to the network's input, and searches can be made for requested subjects as often as required, for local 'selective dissemination of information'(SDI) services." Although it might be easier to hook onto an existing network, the greater relevance of local SDI may be worth of consideration, in particular in the view of using microcomputer systems for both planning and implementation of these networks.

For a microcomputer enthusiast, it might be also worth of considering the use of microcomputers in library settings for administration, accounting, inventory control and other non-bibliographic tasks. Suggestions have been made to produce multimedia educational packages to train and update professionals in the Third World on technical changes and their implications for librarians.

In some developing countries, library schools have taught about library automation for several years. In other countries librarians still feel that information technology is irrelevant to their current situation. These librarians might become interested in microcomputer technology and its applications for reasons like reduced cost, availability of training and documentation, and opportunity for experimentation.

Dorothy Anderson enumerated the major obstacles to the introduction of information technology in the Third World countries.(Anderson, 1983) She observed that "in spite of all the problems noted above, or any particular assortment of those and of others, the number of computer installations in Third World countries is increasing: in areas of government planning, for use in matters arising from national security, in government statistical accounting and administrative procedures, in research institutes, in banks and finance houses, in market research. Even, in some instances, in libraries."

As one of the reasons for the fact that information and information transfer rarely appear to be considered as related to printed publications, Anderson considered that "it is more difficult and more demanding intellectually to design computer programmes for bibliographic matters than it is for statistical data or for worldwide airlines bookings." There seemed to exist a traditional factor: "Library development is rarely considered high priority, in any country's overall development plan, and libraries are more often than not considered deserving only low-scale funding because they are seen as a long-term investment." Anderson rebuked the recommendationthat "the soundest advice to librarians in Third World countries contemplating the introduction of computer systems for bibliographic processes could well be, wait and see, make use of the experience and experiments of others."

However, librarians, trained in information technology either in their countries or abroad, and knowledgeable of the principles and practices of computerized systems cannot no longer afford to wait. In many developing countries assessment of a strategy for the

introduction of information technology has already been extended to library development and to applications of bibliographic services.

In countries with very different cultural and economic environments proposals for solutions carry remarkable similarities. Anderson cited as examples the experiences of such different countries as Saudi Arabia, Singapore, Barbados, Papua New Guinea and Sri Lanka. "In Sri Lanka, for example, a country with a high literacy rate, and a great interest in reading but a language and a script not used worldwide, there are problems in trying to obtein resources to develop a character set for the Sinhalese script..." Anderson acknowledged the need for both internationally acceptable transliteration scheme and for the development of character sets for many more Asian scripts. For the computer hardware and software industry, this development is causing some of the hardest problems.

Many professionals in the field of information have recognized that there can be much frustration and organizational stress when automation is introduced. Often this seems to happen not because it is a new stage in the library development plan but because there is available the computer installed in another agency, a ministry or a university. Similar frustration may arise when assistance received from abroad in the form of hardware and software has to be rejected because the systems are incompatible. If the assistance is accepted, the new systems may fragment rather than assist the development of an integrated national system. Microcomputer technology is, in this regard, to be considered very sensitive because of the almost total lack of standardization, options for independent systems development, continuing innovations and new versions.

Focusing on microcomputer technology, this presentation will include a discussion on hardware and software and their limitations.

III. Information Technology and Microcomputers

The three main types of computers are mainframe computers, minicomputers, and microcomputers. Differences between these types of computers can be defined in a number of ways. One is by considering access to computers. Access to mainframe computers is often limited because of their cost and location in research institutes, corporate headquarters and universities. Mainframe computers are used for general purposes. Minicomputers are used for more specialized purposes by a smaller community of users. Microcomputers are for individual use. The history of microcomputers since the 1970's has been one of highly personal characteristics, not only because microprocessors started the word size for microcomputers at four bits but also because the wide variety of different characteristics in both hardware and software.

The gap between mainframe, minicomputers and microcomputers has narrowed recently: the word size has grown till 32 bits and more which means that the speed has improved remarkably. Two characteristics of microcomputer hardware cause limitations in regard to library applications: storage capacity and processing speed.

Libraries need extensive storage capacity and high processing speed. For example, disks for Apple II hold

approximately 143,000 characters of data on a single disk, equivalent to about 95 pages of text or 180 MARC records. The disks for an IBM PC hold 360,000 characters, equivalent to 240 pages of text or 450 MARC records.

A file can be divided in a logical way and distributed on several floppy disks. Ensuring that the file can be accessed effectively may prove difficult and even in best systems time-comsuming. The hard disks with a capacity of ten or twenty megabytes improve the system but, for most library collections, this is still not a sufficient storage space. More space is needed for growth and expansion. For library use, bibliographic quality is of major concern; abridged non-standard records may become a source of problems when networking of some kind is planned.

Microcomputers are slowest of the three types of computers and, for this reason, not for multi-user systems. The micro-processor is planned to be a personal computer. Local area networks (LANs) are being developed and expanded to provide for multi-user access. Their use in libraries is still more experimental and often reserved for specific tasks, e.g., access to a printer or modem. Individual microcomputers require each their own software, documentation, security and maintenance, and peripherals: printers, modems, casette recorders, mice, etc. These peripherals may add to the versatility of microcomputers but they also slow down the speed: printers for microcomputers are still slower than those for larger computers.

The cost of microcomputers ranges from about US$ 100 to 20.000, depending on the size of the memory, the expandability of the system, the central processing unit, and the number of compatible peripherals, e.g., bar code readers, joy sticks, light pens, and others used for library functions.

The rapid growth and changes of microcomputer technology makes it particularly difficult for librarians also in developing countries to keep abreast of new developments and to assess their possibilities in any given situation. There is simultaneously growing a literature on microcomputer applications for libraries and information services. Unesco's General Information Programme has published several studies. (See: J. M. Griffits. Application of Minicomputers and Microcomputers to Information Handling. Paris: Unesco, 1981. PGI/81/WS/28. on the acquisition of small-scale computer equipment and related software for libraries and information centers.)

IV. Public Libraries as Users of Information Technology

1. Developed Countries

Very recently, only a very few library personnel in developed countries could operate a minicomputer. Data processing personnel was hired rarely in libraries; people with a degree in computer science were employed by research institutes, business and industry. In the annual review of the progress made and pitfalls encountered by the automated library system marketplace during year 1984, Joseph R. Matthews examined the total marketplace activity in the United States as it was represented in four segments: turnkey systems, library-developed software which may be purchased by other libraries, software designed to run exclusively on microcomputers, and production of computer output microform (COM) catalogs. (Matthew, 1985)

For comparison, in the following will be discussed both turnkey systems and microcomputer systems. Turnkey systems had the greatest visibility because they provide a complete package -- hardware, software, installation and training. Turnkey systems also counted for the total of 167 new automated library systems installed in 1984, the increase from 1983 being 68. A total of 769 turnkey automated library systems had been installed worldwide by the end of 1984.

The majority of all systems were relatively small, having eight or fewer terminals. While most libraries were dealing with one vendor, some of the larger libraries, especially libraries who were members of the Association of College and Reserach Libraries, were choosing one vendor for a circulation system and another vendor for acquisitions, serials, or an online catalog. Matthews considered the link for passing data from one system to another an additional cost in order to keep each computer system's data base in "sync" with the other.

Libraries offering software to other libraries increased in number in 1984: A total of 42 library-developed systems were installed in 1984, representing 25 percent of turnkey marketplace activity. Majority of these systems used IBM computers; some systems used DEC, Univac, Honeywell, or Hewlett-Packard computers.

Based on information provided by the libraries, it was estimated that, in 1984, about $2,152,000 was spent to purchase software developed by other libraries. The increase from 1983 was 43 percent. Assuming that a like amount was spent for equipment, i.e., terminals, the computer, disk storage, etc., a total of $4,304,000 was spent by libraries for automated systems using software developed by libraries. One observation can be made; that libraries in the United States have reached the level of using computer technology where interdependence is increasing rapidly.

Microcomputers

Year 1984 marked a new era for microcomputer applications especially for libraries. According to Matthews's report, there are now in the United States, 231 products for library applications that will run on one or more micros, as compared to 98 products that were available at the end of 1983. This represents an increase of 136 percent.

There continues to be a number of options within any functional area: acquisitions, card catalog printing, the online searching/downloading, bibliographies, indexing, media booking, circulation system backup, retrospective conversion, library skills, and other areas including audio-visual equipment inventory, spine label printer, magazine control, OCLC terminal emulator, etc. In addition, micro-based integrated library software is available for acquisitions, cataloging, online catalog and circulation control.

The decision of bibliographic utilities like OCLC to utilize the IBM PC microcomputer as their new cataloging terminal also had a significant impact on the microcomputer marketplace. While there were, in 1983, only seven library-specific products that would run on the IBM PC, by the end of 1984 there were 39. Matthews predicted that IBM PC-based microsoftware can only

increase during 1985. OCLC is currently providing the OCLC Microcomputer Program Exchange service which facilitates the exchange of library related software.

The Apple microcomputer company, with a total of 104 products, continues to dominate the micro software market, but Apple products are primarily for school libraries.

On the basis of 1984 information provided by the American vendors, Matthews estimated that libraries spent about $4,000,000 for library microcomputer software. This amount represented over 33 percent increase from 1983. Matthews also estimated that an additional $4,000,000 was probably spent to purchase the necessary hardware and that, thus, the total expenditures by libraries for library-related microcomputer systems were some $8,000,000.

What was the proportion of public library expenditure for microcomputer systems? The 1984 Bowker National Library Microcomputer Usage Study higlights the fact that public libraries are lagging behind. (Bowker, p. 428) In the United States, 34.5 percent of the 134,408 libraries use microcomputers. Public libraries are using microcomputers the least of the four major types of libraries.

Only 4,990 of the 19,191 public libraries in the United States, or 26.0 percent, actually have microcomputers. (The American public librarians present in this meeting may want to test this information by conducting surveys in their respective regions.) Out of those public libraries which have microcomputers 43.8 percent make them available to the public.

A study sponsored by library vendors surveying both librarians and library users showed a consistent finding: users are more interested in having the technology available than the librarians are to implement it. (Mason, p. 1219)

John Berry commented on the public use of microcomputers which should become a normal pert of library service much like the use of any tool to retrieve, manipulate and organize needed information. (Berry, p. 49)

Robert J. Verbesey reminded that the library is in thebusiness of providing information and recreation to those who live in the community the library serves, and that microcomputers provide information and recreation just like any other service the library offers. (Verbesey, p. 1213)

The North American library literature has abundantly reported on the use of microcomputers: The library staff could utilize a microcomputer to produce catalog cards, to order union lists, reserve lists, newspaper and periodical indexes, to wordprocess memos, letters and other documents. (Fosdick, p. 558) Spreadsheets improve clerical and managerial productivity by budgeting and keeping statistics such as circulation and overdue. A local events calendar is another function suitable for a microcomputer process. Using microcomputer for this type of task would free the librarian to better serve the patron. (Bowker, p. 16)

2. Developing countries

In the developing countries the use of microcomputers is even more varied. Lohner and Koch reported, in 1984, that althoufh microcomputers were increasingly employed in libraries, documentation centers and archives, most of the existing software

packages had been developed for small-scale or specialized applications; only a very limited number of generalized packages making use of the potential of larger micros had been written, and none appeared to be available under terms which encourage their wide dissemination and use in developing countries.(Lohnert and Koch, p. 125) A few packages can be obtained for use in developing countries; CDS/ISIS(Computerized Documentation System/ Integrated Set of Information Systems), developed and maintained by Unesco, which runs on IBM mainframes and certain compatibel equipment, is provided free of charge to Member States along with training and, when necessary, with assistance in installation. Another example is MINISIS, developed and maintained by the International Development Research Centre (IDRC) in Canada, which runs on the HP-3000 series of minicomputers and is provided free of charge to developing countries.

A major constraint for potential users and for international assistance programs is the dependence of software packages on specific microcomputer systems. Unesco has assisted in the preparation of portable software packages which can be adapted to different types of computers and made available free of charge to developing countries. Unesco's assistance includes the installation and maintenance, training of staff and, within the budgetary limits, provision of the hardware. Since developinf countries, that wish to establish mainframe or microcomputer based information systems can at present select from among a relatively large number of available packages, Unesco' priority is in the provision of portable software packages for microcomputer systems. For this purpose Unesco has defined some general features and specific applications requirements which a portable software should fulfill.

Loehner and Koch (Loehner & Koch, 1985) enumerated these requirement as including to support various character sets for the storage, processing and display of data in non-roman alphabets, with the possibility of mixing sets in a single field and of handling user dialogue in alternate character sets; to support general applications needed in libraries and documentation centers, acquisitions control, lending and circulation control, thesaurus management, etc.; and to have the ability to download from an online system to a local data base. Unesco selected for development a software package produced by the Institut fuer Maschinelle Dokumentation (IMD) of the Forschungszentrum Graz: IV+V (Informationsvermittlung und -verarbeitung). For further operational experience, Unesco will implement seven pilot projects in 1985 and 1986. Unesco/PGI's strategy emphasizes that software packages and hardware configurations have to be selected in accordance with the specific needs of countries in order to find optimal solutions. Both software and hardware have to be considered as a mean to achieve the aims enumerated above and cannot be seen as a purpose in itself.

Many questions still remain: Will the software packages developed for the requirements in a different economic and cultural environment meet the needs of the large numbers of other developing countries? Will portability problems and language problems be solved? Whose responsibility will be to provide

documentation and training manuals in several languages? Hopefully these questions will be answered by the concerted effort of librarians and information specialists representing a variety of backgrounds and languages.

Libraries in developing countries are growing and expanding their services. They are, however, still relatively few and lacking of funding and collections. Maurice Line (Line ???) among others has indicated, that "self-sufficiency in individual libraries is even lower than in developed countries, and access to materials held in other libraries is therefore vital if the information needs of the country are to be met at all adequately."

Developed countries have central collections which can be utilized by several libraries. Limited central collections could be justified in many developing countries, the amount of money needed to set them makes it inevitable that union catalogs, despite their inherent disadvantages and problems, will remain the main means of wider access in the near and medium future.

V. Approaches to Solving Problems

IFLA projects of the Division of Regional Activities, funded from a grant from the Canadian International Development Agency (CIDA) have increasingly studied the use of computer technology. For example, library and information systems in nine southern African countries have been studied extensively, both by questionnaires sent to the major institutions in the countries and by personal visits of the investigators, and a report is being prepared. In Asia and Oceania, the online system for regional referral service on experienced library and information personnel (ELIPA) is being constantly updated. Publicity and promotional materials on the use of the database has been sent to national and international agencies.

The First African-American IFLA Pre-Conference Seminar, In Nairobi, Kenya, recommended that a national commission be established in each developing country to determine information system needs and to set criteria for the implementation of a national plan. (De Loach, p. 62) Standards should be established in the country's national plan, both for hardware and software which should be designed to support indigenous languages.

The Technical Standards for Library Automation Committee (TESLA) of the Library and Information Technology Association of American Library Association suggested, in the 1984 ALA Midwinter meetings, a list of needed technical standards. It stated briefly, regarding standards relating to use of microcomputers in libraries that "no specific needs have been identified but they probably exist" and that the development "will be monitored." (Carter, 1984) TESLA also indicated that telecommunications standards "generally exist but a set of guidelines is needed for library spplications." Most of the more than 20 suggestions require further investigation and were discussed in depth in a TESLA-sponsored program at the 1985 ALA Annual Meeting in Chicago.

Much has been written and said about the usefulness and appropriateness of microcomputers in the public library. The most recent action, in the United States, has been at how the library itself can use the somputer or how patrons can benefit through

better services provided by a library's utilization of microcomputers. (Fowler & Duncan, p. 47.) Libraries are setting up public access microcomputers for patrons of all ages. While the goals may differ, their stories tell of "the magical mix of libraries, people and machines."

-The Clinton-Essex-Franklin(NY) Library system made Apple computers available to the patrons to promote computer literacy among rural youngsters with limited exposure to technological innovations. The computers also attracted many children who were not library users. (Romans & Ransom, p. 693)

-The Lorain (Ohio) Community Development Department made funds available for five microcomputers to be placed in the public library. A staff-initiated program provided provided BASIC programming courses for low to moderate income residents. ("Community...", p. 1804)

-In Menlo Park (Calif.), the Public Library has computers available to children in the afternoon and to adults at all other times. Adults use the computers to test different brands of microcomputers for purchase, career changes and for programming. (Harvie, p. 604)

-The Lincoln City (Nebraska) Public Library summer reading program offered young adults and children the opportunity to read books to gain time for using the library's microcomputers. (Opocensky, p. 39)

-The Columbus(Ohio) and Fanklin County Library System and OCLC sponsored a reading program using microcomputers to reach adults with severe reading difficulties. The targeted audience used computers to understand practical matters such as road signs, recipes and job applications forms. ("Columbus...", p. 2134)

Based on these examples, libraries can capitalize on the improved computer literacy microcomputers provide to expand library services. Paul Zurkowski observed that by providing a non-challenging environment in the microcomputer area, a meeting place for computer clubs, services of a data base advisory committee, and by highlighting the varied applications of public access microcomputers will go far to show the emerging role of librarians in the information context. (Zurkowski, p. 1383)

VI. Preparing for the Microcomputer

For the consideration of those librarians who will get involved with planning and implementation of microcomputer systems, the following list presents six items of priority:

(1) The need for a microcomputer system in the public library should be established.

(2) Potential users among the personnel and the patrons should be polled to identify special interests and needs.

(3) The librarian(s) should attend training seminars, conferences, exhibits, and read literature on microcomputers. It is extremely important to have some well-guided hands-on experience using, if possible, different types of microcomputers. Reliable dealers, even from abroad, generally welcome the opportunity to provide training while promoting their products.

(4) A consultant can be hired for planning, training and installation.

(5) The microcomputer literature, especially research reports, reviews, guides and handbooks for introducing

information technology should be consulted, compared and assessed in regard to local needs and resources.

(6) Decisions on the selection of software should be based on suitability of programs for identified use and compatibility with hardware available or to be purchased.

This list is not exhaustive but represents the basic idea of user-centered microcomputer system as opposed to machine-centered system. The system purchased will always be measured against the expectations of the librarians even if those expectations are unrealistic, in which case the library personnel may feel that they were cheated or forced to purchase an unsuitable system. (Epstein, p. 1303) The library personnel will find that the long-term benefits of the investment of time and effort in selection and implementation of microcomputer software and systems outweigh the costs. Kesner & Jones stated: "In particular, they will be in position to insure that the system addresses their immediate needs and is sufficiently flexible to afford migration paths as the technology matures and as new requirements materialize in the work place. This argument is most germane to those applications that integrate single discrete bibliographic functions, such as circulation, serials management, or cataloging, with standard office operations, such as word processing and financial administration. On this basis, the cost-benefit arguments in favor for the use of microcomputers in traditional library applications may prove overwhelming." (Kesner & Jones, p. 135)

VII. Conclusions

Libraries in all countries need to develop policies that will preserve a freedom and equality of access to information in electronic form without allowing abuses. In the United States, the National Commission on Libraries and Information Science and the American Library Association have as their major objective work towards an infrastructure for electronically stored and delivered information comparable to that existing for the bibliographic control of printed materials. This task requires strong and imaginative leadership, wide cooperation, and public support to ensure access for all.

The importance of education and training, whether formal oe informal, at work place or abroad, cannot be overemphasized.

Fredrick G. Kilgour, the former president of the OCLC, wrote in 1973: "To make effective decisions in the area of library automation, librarians must know much more about computation than they think they must know."

Dorothy Anderson, the director of the UBC Office then, wrote in 1974: "Our future with the computer will need more and more librarians and documentalists to learn and to go on learning; and it will be no mean advantage if that learning is done with its objective national participation in an international communications network."

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STATISTICAL MEASURES FOR LIBRARY ACCOUNTABILITY

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Abstract

Prior statistical measures on library accountability used input characteristics and inter-library comparisons as a basis for developing standards. This gave way to an emphasis on planning, budgeting, and marketing concerns with a focus on output measures. However, the output measures are not a function of library activity but result from characteristics of the user population. Output measures are beyond library control and their use as a measure of library performance may be questioned. This led to an investigation of methodological bias in library research. Findings showed that certain research programs used exclusively a single methodology--even when different methodologies would have been appropriate. User needs research and bibliometrics showed undue methodological bias and proposals are offered for correcting this. It is contended that methodological bias limits problem definition and inhibits theoretical and practical progress.

STATISTICAL MEASURES FOR LIBRARY ACCOUNTABILITY

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Input Measures and Inter-Library Comparisons

Until 1970, two major themes permeated any discussion of public library accountability: (1) a concern for input measures, and (2) the notion that the measurement of public library performance was to be based on comparing one library to other libraries. These two tenets of performance were fully integrated into prior statements of standards and they constituted assumptions which were so ingrained in the concept of accountability that they were rarely discussed.

Input measures included finances, collections, and the resources needed to staff a library and offer its services. Common input measures included the following: income per capita, volumes per capita, size of staff, acquisition rates, hours of service, size of building, and periodical holdings. These input variables or ratio measures were of great benefit in providing the justification and incentive for libraries to develop, grow, and prosper--especially when a library fell short of some standard set by a national library agency or professional association.

The other methodology--that of inter-library comparison--worked well with input data. It was statistical analyses of inter-library data which usually led to the establishment of

thresholds, benchmarks, and standards for input data.

The 1970's saw a shift in the thinking of library leaders and the importance of input data and inter-library comparisons waned. It was felt that the measurement of services--outputs--was more important than studying library characteristics--inputs. The output measures typically included circulation (per capita and per volume), reference transactions, browsing, response time, materials availability, and other user centered services measured as either aggregate scores or as ratios such as per capita measures.

Concurrently, inter-library comparisons were replaced by management techniques which focused on a single library: planning, budgeting, and marketing. Thus, the 70's saw interest in innovation, community analysis, user studies, and output measures. Library statistical measures were now being plotted over time with the expectation that circulation or reference would always increase from one year to the next.

Problems with Output Measures

By the 1980's, it was soon realized that the swing to output measures and the emphasis on management techniques forced libraries to confront an unreasonable and illogical principle: that library characteristics caused users to exhibit certain degrees of library use. In other words, the new hidden

assumption was that a library output was primarily influenced by a library input. This assumption took two forms: (1) the building of statistical models where inputs (such as income) were hypothesized to explain outputs (such as circulation); and, (2) the notion that the library, through marketing or acquisition, could have a direct influence on and even a manipulation of use. There is a small group of library researchers in North America who privately state that such premises are no better than astrology at explaining or predicting library use.

The argument against linking input characteristics to output measures extends to an indictment of the output measures themselves. The components of this argument follow. (1) It was true that inputs did not cause outputs. Having a large collection did not insure high circulation figures. However, larger collections tended to be associated with higher circulation figures and thus there was usually a statistically significant correlation between input and output variables. (2) There was growing recognition that there was a spurious causal link between output characteristics as a function of library performance. It was known that outputs such as circulation per capita or circulation per volume could be influenced by buying popular materials or by marketing tactics. Nonetheless,

there was a limit to such influence and it is now being recognized that user characteristics explain an individual's library behavior. (3) It is known that the variability in an individual's reading and library use is a function of personal charactistic variables. Output measures, such as circulation, may be beyond the library's ability to influence it in any long term, significant way. If libraries wish to have an upward spiral to show continuously increasing circulation then they may have to resort to changing the intelligence level, education, and even the reading habits of their service population. (4) It is difficult to interpret output statistics since high scores may be due to user characteristics and not library performance. Low scores may not be due to any fault of the library. It would be illogical for libraries to receive credit or take blame for their output scores. There are articles by D'Elia and Van House on this in the forthcoming issue of Public Libraries (scheduled for Fall 1985). (5) Although libraries are able to collect output measures, the results have become difficult to interpret. It is hard to ascribe meaning to any particular score and it is equally difficult to assess library performance based on the scores. Comparing libraries on their output scores leads to a comparison of the communities the various libraries serve. (6) It is possible that output

measures may meet a fate similar to input standards. If so, then the popularity of output measures will diminish during the rest of this decade.

Library Accountability for Other Types of Libraries

School and academic libraries experienced sporadic attempts at justifying their existence using statistical measures. Normally, qualitative rather than quantitative measures were incorporated into accrediting standards and measures of self governance. However, a concern for input measures dominated most statistical studies of academic and school libraries. There was a growing reliance on user studies as a measure of effectiveness.

Special libraries were, until recently, considered too difficult to evaluate with general variables or measures applicable across libraries. That is changing and cost benefit studies are now emerging to evaluate the worth and importance of special libraries. The work of Paul Kantor is notable in proposing and testing performance measures for both academic and special libraries.[1-3]

Kantor's work is different from the other studies in that he uses a research methodology not normally found in library research. In most of the performance measures studies there was adherence to an unwritten rule that each researcher use

similar methods in investigating an unfolding problem. In his academic library study, Kantor relied on the methods developed in the 1970's by Tukey for Exploratory Data Analysis. In earlier studies, Dyer and I had used methods which were a departure from normally accepted methodology. This called into question two issues: (1) Were statistical techniques and entire methodologies determined before problem selection or after it; and, (2) Was there widespread consistency of methodology across studies in the same problem area?

Examination of Library and Information Science Abstracts (LISA)

During 1984, LISA contained almost 7000 abstracts with good international coverage. I examined all of the abstracts related to the Use of Libraries and Library Materials and bibliometrics in an attempt to determine if these areas employed a variety of methodologies of a single one. The assumption for this investigation was a hunch that there might be self imposed limitations on our research. If this were true, then it might limit the way in which we define problems, establish research agendas, and select statistical measures. All of this would have a bearing on the problems associated with input and output measures, accountability, and performance studies. The restriction to 1984 abstracts represents a pilot investigation to see if a larger, more comprehensive study is needed on the

recurring use of similar statistical measures which could indicate methodological bias.

Evaluating several hundred abstracts was most revealing. Rarely did researchers use anything other than the commonly accepted methodology for their particular area. In study after study and in country after country the researchers adhered to a single methodology. Each research area seemed to have its own special way of doing research and it was rare that there were any cross-methodological checks of findings. In fact, no such studies were identified through this limited check of the abstracts. More subject areas and actual journal articles will have to be examined before this finding can be verified. What did emerge from this pilot study can be described in more detail since it portends serious implications for research programs in library and information science.

Methodological Bias

There appears to be sustained and systematic bias in the selection of statistical techniques used to analyze library and information science research data. This bias is evident in that certain subject areas of our research appear to depend on the use of a limited repertoire of statistical techniques to analyze data. It may also be true that certain researchers always favor use of the same or at least similar statistical

methods. It is disconcerting that entire areas of library research may be warped by methodological redundancy. Further, it is contended that the use of any particular statistical technique influences the way in which hypotheses are developed and even the way in which research problems are defined. These statistical limitations lead directly to methodological bias which can inhibit progress in developing theory or explaining practice.

Examples of several of the patterns of statistical bias may shed light on the magnitude of this issue.

User and Use Studies

Library user studies employ the methodology of interviews or questionnaires. The only exception to this were the studies based on library records but these are more properly classed as use studies and not user studies. One study of browsing used an observation technique but all other empirical user studies were questionnaire or interview surveys.

Yet, the use of questionnaires to study user needs makes a methodological assumption which, in turn, shapes the very types of hypotheses which can be developed. This often restricted the user needs problem to a study of relationships of nominal level variables using categorical response sets (e.g., type of use--reference, periodicals, browsing--cross tabulated by type of user--student, manager, teacher). In turn,

these cross tabulations lead directly to chi-square tests of statistical significance where type of user is hypothesized to be significantly related to type of use.

Those who reject the chi-square bias tend to favor a different form of methodological redundancy. These researchers who claim more sophistication attack the user needs problem as a study of relationships. In their questionnaires, they scale use to make it an interval or ratio level variable (e.g., number of reference uses, amount of time browsing). They also look to more sophisticated user variables (e.g., level of education, distance to library) and this allows their data to be subject to correlational analyses. Instead of contingency tables, they have scattergrams; instead of chi-square results, they have correlation coefficients and regression models. Nonetheless, their statistical bias gets repeated in study after study. Once the researcher decides to use a questionnaire, then the alternatives for hypotheses, variables, and data analyses have also been decided or at least narrowed.

The limitation across user needs studies reveals that there is a plethora of questionnaires reporting similar results but there is a lack of theory to explain progress in furthering our understanding of user needs as it relates to library and information services. Even at the practical level, the

questionnaires often yield results so expected that little new information is gained from a study which employs a methodology similar in every regard to previous studies.

It is contended that the continuing use of chi-square or correlational statistical analyses does damage beyond proving that our research is repetitive. Statistical bias limits the way in which a person thinks about a research idea. Kaplan discusses this bias as the law of the instrument which he summarized as: "Give a small boy a hammer, and he will find that everything he encounters needs pounding."[4] But the real damage here is that if you assume the only tool you have is a hammer, then every problem will tend to look like a nail. The chi-square or correlational link to questionnaires represents such a bias. Ths researcher assumes that this methodological format will address just about any research problem related to user needs and this assumption limits and defines the way in which hypotheses are then formulated and developed.

Bibliometric Studies

Unfortunately, the user needs problem is not alone in its limited use of a single methodology. Bibliometric studies share their own bias in that the vast majority of these use hyperbolic distributions as a descriptive statistic to describe author productivity or journal importance. Each new

bibliometric study sounded like each previous bibliometric study since the researchers' methodological bias involves the same rank order relations. In fact, Rapoport had claimed that the distributions used in rank order relations will apply to any phenomena which is ranked and then cumulated.[5] Thus, if you ranked the cities of the world by population you will get a bibliometric type of distribution. This same distribution would emerge if you ranked rivers by the volume of water they carry, books by the numbers of pages they contain, or even lizards by the numer of species found in the desert.[6] Bibliometrics uses distributions which depict such rank order relations and although this has benefits it does not explain why certain authors are more productive than others or why certain journals are cited more frequently than other journals. It is noteworthy that questionnaires have rarely been used to study citation practices or author productivity. The irony of this is that such surveys might provide the basis for explaining why the bibliometric patterns exist.

Conversely, the bibliometric distributions might be of benefit in user surveys where, for example, a small percentage of the users account for a disproportionately large percentage of the use. Clark, for instance, found that about six percent of public library users account for almost thirty percent of the total library use.[7] This use pattern might be better

described amd predicted with a bibliometric distribution in lieu of more conventional descriptive statistics.

Other Research Programs

The next area to be investigated will be studies of document retrieval and indexing language use. Typically, these relevance studies use experimental designs which occasionally manipulate an independent variable. Users are typically asked to make judgments on index terms, other surrogates, or full text documents. Responses are recorded using open ended or closed set approaches. It is suspected that with one exception (online public access catalog studies) it will be rare to find alternative methodologies used in these studies. These studies often report on numerous variables gathered from small numbers of individuals who participate in the experiment. As a rule of thumb, there should be a minimum of ten cases (or individuals) for each variable studied;[8] thirty cases per variable would be more desirable. It would be interesting if users are asked to record their memory of their prior behaviors with indexes. If so, then such studies would lend themselves to surveys which could involve far larger sample sizes and which could carry more variables.

It may be possible to compare the relevance/document retrieval research with the recent studies of online public

access catalogs. The work of Markey and others is encouraging since various methodologies were used to study different aspects of the catalog use problem. These studies contain elements of both the experimental and the survey methodologies. However, it is unknown at this time if bibliometric distributions are used in describing catalog users' behaviors. It is known that even large catalogs follow a Lotka distribution and it would be expected that subject groupings and citation patterns would follow a Bradford distribution. It would be interesting then to see if users' search procedures mimic these distributions where the majority of users would do limited searching while only a small number persist in doing extensive searching.

Summary

Cross-methodological investigations increase the external validity of research when the results using one method are compared to results obtained using a different method. This also forces the researcher to reassess the research problem from a different perspective. It reorders the assumptions surrounding the research and it influences variable selection as well as data analysis.

A preliminary investigation of recent user studies and bibliometric studies confirms the hypotheses that several

specific research programs are limited to the use of a single methodology. Benefits could accrue to these research programs if the results of different methodologies were used to examine more facets of the problem under investigation.

This investigation will continue to assess the presence of methodological bias in selected research programs. The purpose here is not to indict our research but to propose the use of alternative methodologies which could increase our understanding of problems important to our field. The next steps in this investigation are to expand the amount of research examined by looking at primary literature over a period of years. Major studies in each area may be identified using citation as a measure of importance. Then, the methodology will be examined in greater detail.

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